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TELEPHONE JOKES.

The admirable little address by Mr. J. J. Carty before the New York Electrical Society on the occasion of its visit last week to the new Cortlandt Street telephone exchange brought out very clearly the enormous expense and the great amount of work necessary in keeping the system up in efficiency and on a scale commensurate with the growth of the population and the needs of the community. It has always seemed to us that the New York telephone service aimed consistently at a high standard, and succeeded in attaining it, while the adoption of the measured basis put that service within the reach of everybody who would rather telephone than travel. In the course of his interesting remarks Mr. Carty touched indirectly upon the share of the public in getting good results, when he referred to the foolish practical joking with which the lines were often burdened. As he said, last year the calls for Mr. Fish at the Aquarium were so numerous while the joke was fresh and victims were plenty, that they had to put on extra operators to intercept the messages. We happen to know of cases where Mr. Stiff has been asked for at the Morgue, and during the present wintry week Messrs. Snow and Frost have been residuary legatees for kindred tomfoolery at the telephone number of the Street Cleaning Bureau and other similar addresses. It is all very funny, of course, but it is just that joking and loading the lines and operators with unnecessary work that militates against satisfactory service. Fortunately, the measured system of payment for each call stops much of this wretched foolery, but there are still lots of telephone users willing to pay 5 or 10 cents to "make fools" of other people, and to block business. Quite unfairly the reproach for it all falls upon the system that suffers from it.

THE EFFECT OF ELECTRIC WAVES ON THE HUMAN BRAIN.

The article of Mr. A. F. Collins on page 335 contains a number of interesting suggestions. It opens avenues by which the obscure subject of telepathy may be logically reached, as well as the possibilities in the horizon of electro-therapy. The only danger lies in drawing conclusions too hastily. Electric waves permeate all matter, except the best electric conductors. In permeating and traversing matter, these waves must produce some effect, however small it may be. The brain of an animal, regarded as a mass of material, is capable of being traversed to some extent by electric waves, and such waves as may traverse it must produce some effect in transit, however small the effect may be. The only question is to what extent do the waves permeate it, and how much influence can they produce. The influence might be very considerable, and yet be of such a nature as not to become manifested, either objectively or subjectively. Or the influence produced by the electromagnetic waves passing through the substance of the brain upon that substance, might be so infinitesimally small as to produce no significant effect.

Mr. Collins adduces certain experiments upon the living head of a cat to show that electric waves, produced in the neighborhood of the animal, brought about observed electric changes in the head. Granting that the experimental results are correctly described, it does not necessarily follow that those changes would have occurred in the said head if the testing apparatus or electric detecting apparatus had not been applied to them. In other words, the application of the electric apparatus to the head may have so modified the conditions, that the electric waves obtained access to the interior of the head in a manner which would otherwise have been impossible. Holes were drilled in the skull of the animal and wires introduced

into the holes. Wires are the things which catch, entangle and lead electric waves, and it is, therefore, unsafe to conclude that because with such wires applied to the lining membranes of the skull electric effects were found to follow each set of waves produced by the oscillator, therefore the same waves without any wires would have produced the same results.

The brain is invested by highly vascular tissues and is a highly vascular substance. The external vascular tissues contain blood which is a fairly good conductor, and consequently the brain is shielded to a certain extent, although perhaps only to a limited extent, from external electromagnetic wave action. If this shield be virtually removed, by leading wires into the brain for the purpose of detecting coherer changes, it is immediately open to question how far those changes are *propter hoc* instead of *post hoc*. We think, therefore, that broadly speaking, electromagnetic waves must produce some effect on the brain, and that possibly these effects may be very appreciable under certain favorable conditions; also that Mr. Collins may have observed some of these effects. Such experiments should be made with the greatest care. The more such experiments are made, and the greater care that is taken in making them, the more interesting and valuable the results will be. Meanwhile, if any persons are found to be in real danger of their lives from electric waves in thunderstorms, as Mr. Collins believes is sometimes the case, the right thing to do is to shut them up during the storms in a tightly closed metal box, with a grating ventilator, just as we shut up the receiving coherer in the neighborhood of wireless telegraph sending apparatus. We fear, however, that the demand for such thunderstorm electric shelters is not likely to be sufficient to render the business of their manufacture profitable.

THE LIGHT OF THE ENCLOSED ARC.

The interesting note on a spectro-photometric study of the enclosed arc which we print this week forms an appropriate complement to Dr. Bell's preliminary study published Feb. 1. Mr. Smith's comparisons show in a most striking manner the remarkable differences in light distribution between the light of the sky and that from the enclosed arc on one hand and the Nernst lamp on the other. It must be remembered, of course, that skylight is wonderfully different from sunlight in color value. The selective absorption and reflection from small particles that give to the sunset its crimson and to the sky its blue, indicate a very wide departure from the normal light distribution of the solar spectrum. This is very conspicuous in the comparison between the Nernst lamp and the sky. On the showing there made, if the skylight were white the Nernst lamp ought to show a deep orange. On the contrary, the latter, weak as it apparently is in the blue, is really fairly near to white as compared with ordinary average sunlight, while the enclosed arc is strikingly bluish white.

One of the curious and interesting features of color photometry is the absence of any practical color standard. Sunlight may be anything from a rather bluish white to orange or orange red, and a spectro-photometric comparison made with sunlight depends on the altitude of the sun and the clearness of the air. It would be of no small value to science if in the list of necessary photometric work the constitution of a normal color standard could be placed near the head. It is perhaps unkind to make this suggestion, for the photometric experts have a plentitude of troubles already, but we really need their help. The word white, for instance, ought to mean, by general convention at least, one definite and reproducible thing. At present we not only lack a satisfactory standard of intensity, but one of color as well, and there is plenty of work cut out for investigators who, like Mr. Smith, have the skill and the apparatus to undertake a task so difficult.

THE JUBILEE OF A GREAT UNIVERSITY.

As we go to press there is being held at Baltimore a notable celebration at the Johns Hopkins University, marking a full quarter century of notable work, and, unhappily for the institution, the retirement of its distinguished president, Daniel Coit Gilman. Dr. Gilman has been an unique figure in the progress of American education. He assumed the initiation and development of Johns Hopkins University at a time when American universities were a byword, and with few exceptions American colleges were strangled by hidebound conservatism. University, to the ordinary American layman, meant merely the addition of a law school, a theological school and a school of pharmacy or dentistry to a narrow sectarian foundation where the trustees insisted on having a good sectarian before a good instructor. Every student who hoped for better things and longed to pursue his studies after taking his baccalaureate degree headed straightway for Germany, there to unlearn what he had been taught here. Dr. Gilman took up his great work with different and higher ideals, and thanks to a far-sighted and liberal board of trustees, he carried them out with the strong courage of his convictions. He took his stand for academic freedom and learning for its own sake and steadily, tactfully, if need be stubbornly, maintained it through sunshine and storm. If public opinion hampered him he held his ground and won it over. Through every difficulty he persisted, always keeping that one strong ideal before him, and now, after a quarter of a century, in laying down his task to assume the direction of an even greater one, in large measure made possible by the stimulus he had given to scientific education, he may well look back with pride on his achievements.

Johns Hopkins University occupies an unique place in American education. It represents perhaps more fully than any German university, because of fewer trammelling traditions, the Germanic conception of academic freedom. It stands apart from all other American institutions in the dominant influence of the purely post-graduate work over the university and its whole environment. There are, of course, some few institutions in which there is no undergraduate work, but no one of them has carried so strong a general influence for university ideals. Perhaps the strongest evidence of the fundamental character of the institution is the fact that the one criticism which could fairly be passed upon the post-graduate student body is an excess of feverish activity, of over haste, in plunging into work. The present celebration sees a gathering of graduates that represents the influence of the university on American education to an extent that could hardly be paralleled. The new president, Dr. Ira Remsen, has the universal indorsement of the alumni, and is amply fitted to take up the work where Dr. Gilman lays it down. Of late years the Johns Hopkins University has suffered severely from lack of funds due to the depreciation of its investments, but Baltimore has stood staunchly behind it, and if we mistake not generous friends will at this time see to it that its valiant work in the cause of science shall not go unrewarded. The work of Rowland alone has been enough to justify the whole foundation, and others no less distinguished in their respective fields of research have joined in giving the University a reputation of which the country at large may well be proud.

STATIC STRAINS IN HIGH-TENSION CIRCUITS.

The paper read at the recent meeting of the American Institute of Electrical Engineers upon the subject of the static strains to which high-tension circuits are subjected, is interesting, as showing the growing tendency to raise the pressure of long-distance electric transmission circuits, and to introduce resemblances between such circuits and frictional electric appartus, or high-tension electric apparatus generally. At the present time, the insulators and modes of insulation of wires and transformers on long-distance transmission lines

suggest a partial return to frictional electric apparatus, as developed by Franklin and others in the eighteenth century before the advent of the voltaic cell and voltaic circuit. It is evident that there are two difficulties to be dealt with in high-tension circuits, so far as static strains are concerned. One is the static effect of lightning or of disturbance from without, and the other is the static effect of sudden changes of load, or of disturbance from within. The surges due to lightning are not confined to high-tension circuits, but the higher the normal pressure of the circuit the more difficult becomes discrimination between abnormal stresses due to lightning, and the normal stresses due to the working machinery. It becomes difficult to educate lightning arresters to operate properly on high-tension circuits. These effects of lightning are always a source of difficulty in all transmission circuits.

The surges due to internal causes are, of course, more readily capable of control than those due to lightning. As regards underground lines, there seems to be but little danger from surges, at pressures hitherto employed in practice. In overhead lines the surges are more serious, and more likely to occasion a breakdown of the system. The protective devices recommended in the paper are condensers and choking coils. Of these it would seem that the condensers are the better safeguards against short circuit or accidental current change, because they absorb the electrostatic energy, and reactance coils are the better safeguards against sudden potential changes because they absorb the electro-magnetic energy. Consequently, as the sudden current changes appear to be the more formidable of the two dangers in practice, it would seem that the condensers are the more important adjunct. An interesting fact alluded to in Mr. Thomas' paper was the rapid increase of the leakage current and energy loss in condensers attending a rise of temperature. It is known that the condenser may be made the most efficient of all known apparatus for a given activity or energy storage capacity. The loss of energy in them is partly hysteretic and partly due to conductance. It would be interesting to ascertain how elevation of temperature affects these two components.

MAGNETIC CLUTCHES AND INDUCTION MOTORS

In one of the discussions before the recent Northwestern Electrical Convention, it was suggested that the magnetic clutch offers a satisfactory solution of the problem of how to run electric elevators and apparatus of a similar nature with induction motors. Indeed, Mr. Rau spoke quite confidently to the effect that the elevator problem is solved by the use of the magnetic clutch. Aside from its use in the Arnold central station arrangement, the magnetic clutch has been little applied in larger work, but we understand that at least gratifying progress has lately been made in the development of such devices for use with large motors. The idea, of course, in employing a magnetic clutch in elevator work is to allow the motor to run constantly, and connect it with the elevator machine through the medium of the clutch. The motor would in such case start its full load while running at full speed, and while working with a better power factor than when exerting full torque from a state of rest, thereby obviating the extreme current and voltage fluctuations which are the horror of the central station man, and have caused him to consider the induction motor as it has been applied in the past out of the question for electric elevator work if run from mains used to distribute both light and power. In rough-and-tumble mine work where regulation is a secondary matter, the induction motor is commonly geared directly to a hoist and is started and stopped by means of a controller, which inserts resistance in the armature or rotor circuit at starting. This appears to be the method which offers the least interference with the line voltage of any that has been devised if the motor itself is geared directly to, and starts with, the load. The scheme is, however, hardly applicable to modern elevator service, and the same may be said of the plan of belting an induction motor to the old-fashioned elevator machine formerly used to operate freight elevators from constantly driven line shafts through friction clutches.

If the development of magnetic clutches can really bring about the placing of the induction motor, either polyphase or single-phase, on an equality with the direct-current motor for operating electric elevators and for intermittent work of a similar character, it would mean much to the art of electric light and power distribution for all purposes by one uniform system of alternating current. Aside from intermittent work of the electric elevator character, present alternating-current systems of light and power distribution, either by polyphase or single-phase currents, have demonstrated themselves to be entirely applicable to general distribution of light and power upon a uniform plan suited to all common uses, without the use of rotary converters. The present existence of large direct-current networks in many large cities with a great number of direct-curent motors connected thereto, is claimed to make any but the direct-current distribution system out of the question in such cities. There are, however, plenty of other smaller cities and towns where the chief present objection to the use of polyphase current distribution for all purposes, both light and power, is the difficulty in starting loaded induction motors without destroying the regulation of voltage over the system. Central stations will, therefore, be apt to maintain their 500 and 220-volt power circuits to take care of elevators and similar service until some method of running them by induction motors can be devised which will be as satisfactory as the operation of elevator motors off the direct-current three-wire network in large cities. If the direct-current service is maintained for the elevator work, many other motors will probably be connected on the same circuit to give the generator a load, but even this does not overcome the many objections to having two classes of generators and circuits. Again, in some of the smaller towns there is sometimes enough business in sight to warrant running 24 hours, and give a day service for light and power, provided all the service can be supplied from one generator, but not otherwise. In such cases there is not likely to be any electric elevator load, but there is apt to be, in the aggregation of local industries to which power can be supplied, some intermittent business of a similar nature which the development of a magnetic clutch would make easily handled, and in many cases determining whether the power service could be undertaken with profit.

From the standpoint of the designer and inventor, the magnetic clutch would seem to offer many advantages over the purely mechanical clutch, not only in simplicity of control from a distance, without the intervention of rods and levers, but in ease of regulation. All who have had to operate mechanical clutches know how hard it is without close attention to apply the mechanical force necessary to operate the clutch steadily and without jerk. Not only is the human hand likely to be unsteady in applying the pressure, but no matter how steady the man, the unevenness in the working of the clutch mechanism makes it difficult to apply the clutch so as to obtain an even torque. With a magnetic clutch there would be a definite current supply for each position of the controlling handle and means to regulate the torque afforded by the motor in starting the machine to whatever maximum might seem desirable without leaving it to the judgment of the operator. This feature would prevent the use, through carelessness, of the excessive current it is so desired to avoid in starting, and perhaps would be fully as valuable in reducing the starting current from the fact that the motor would run at full speed and best power factor when exerting its greatest torque.

New York Central Railroad Plans for Electricity.

It was doubtless to offset certain rumors that Senator Chauncey M. Depew and J. Pierpont Morgan, directors of the New York Central, called upon Mayor Low on Feb. 18 and were with him nearly an hour. Corporation Counsel Rives took part in the conference. The Mayor gave out the following memorandum, which he said contained all that was of public interest in connection with the conference:

Mr. Depew and Mr. Morgan called to-day to say that the New York Central Railroad desires to co-operate with the city in every proper way in improving the conditions in the tunnel, and it will give to the Mayor any formal assurance that may be required of its intention to substitute electricity for steam as rapidly as practicable. In the meanwhile it proposes to submit its present plans and to confer with the Corporation Counsel as to the legislation required to permit it to substitute electricity for steam.

Reports have been given wide circulation that the elaborate plans for the adoption of electricity with which the New York Central Railroad had been filling the columns of the daily papers were merely a "bluff." It was said that the company had no serious intention of using electricity at all, and wished merely to save time by satisfying popular clamor on the subject. In support of these assertions, various schemes have been attributed to the management, all based upon the rejection of electricity. It will now be noted that the company has made its promise as to electric traction as formal and definite as possible. Meantime, Mr. Bion J. Arnold has been actively engaged by the company as its consulting electrical engineer, and no small amount of work has already been done in investigating the data connected with the subject.

In this connection, other rumors have recently been in circulation as to what the Central would do if it adopted electricity, and its name has been mentioned in connection with proposed Manhattan and Metropolitan deals. It is asserted that the Central could obtain from one or both of these without difficulty all the current needed for the operation of the tunnel, and upon this hypothesis has been built up a scheme crediting the Central with an underlying intention to control the local transportation system of New York City. In recent movements of the stock of the Manhattan and Metropolitan companies, the names of the Vanderbilts, Mr. Morgan and the New York Central have been freely used.

Electrical Engineers of the Day—XXXIV.

A. M. HUNT.

Andrew Murray Hunt was born at Sioux City, Iowa, in 1859. His early education was received in the common schools of Sioux City and Indianapolis. In 1875 he was appointed to the Naval Academy as cadet engineer from the State of Indiana, and was graduated near the head of his class four years later. During his naval career he served at sea as engineer officer on the warships "Powhattan," "Tennessee," "Richmond" and "Atlanta," and the Fish Commission steamer "Albatross." During his service ashore, he spent one year as instructor in mechanical engineering at the Orchard Lake Military Academy, Mich., two years as steel inspector in Pittsburg, and one year as member of the Naval Steel Inspection Board. The appointment of an officer so young on the latter board at a period when its functions were of unusual importance, was a well-deserved recognition of the thorough mastery Mr. Hunt had made of the subject of his duties during his previous service on steel inspection. While inspector of steel, Mr. Hunt had charge of the chemical work in this line, and was frequently called on to report on the composition of special metals procured by representatives of the Navy Department abroad.

While attached to the "Albatross," he was called on to investigate an obscure case of disintegration and pitting of the condenser tubes on the United States steamer "Baltimore," to carry out which he started the chemical laboratory at the Mare Island Navy Yard, which since that time has been regularly used in testing materials furnished to the Navy Department on the Pacific Coast.

In the Fall of 1893, while chief engineer of the "Albatross," Mr. Hunt was detailed as chief of the department of mechanical arts for the Midwinter Fair in San Francisco, at the expiration of which duty in July, 1894, he resigned his commission and entered into partnership with Mr. W. F. C. Hasson as consulting engineers in San Francisco, Calif. While connected with this firm, he was identified with much of the early transmission work on the Pacific Coast, including the pioneer Sacramento-Folsom transmission plant, the high voltage transmission plants of the Nevada County Electric Power Company and the San Gabriel Electric Company, and the transmission plant for Victoria, B. C. He also installed a number of steam-driven isolated plants, and had direct charge of the important work connected with the conversion of the cable roads of Los Angeles to electricity.

The winter of 1897 and 1898 was spent in Alaska, where he built four steamers for service on the Yukon River. Mr. Hunt's resource and ability to carry out work under difficulties were particularly displayed in this undertaking. These four boats, 225 ft. long and 40 ft. beam, were built in five months' time, in a country where there were no shops, and where lumber and other materials had to be rafted ashore, and in a climate where snow and cold were a serious handicap.

In January, 1899, Mr. Hunt resumed consulting engineering work in association with Mr. E. H. Benjamin and Mr. Wynn Meredith. In April of that year, he was appointed consulting engineer for Mr. Claus Spreckels in the erection of the plant of the Independent Electric Light & Power Company in San Francisco, which is one of the model city lighting and power plants of the world. This plant is located at a distance from the center of the city, and has installed about 20 miles of underground cable, transmitting current at 11,000 volts to sub-stations. Subsequently, he became general manager of the Independent Company, which now has an installed capacity of 6500 kw, and later also general manager of the Independent Gas & Power Company, which is just completing a new plant.

Mr. Hunt still retains his connection with the "Engineering Offices," on the staff of which he has also associated Professor C. L. Cory, dean of the College of Mechanics at the University of California. The combination of men associated under the name of "Engineering Offices" is thus particularly strong, including engineers of large experience in all the lines of engineering work carried on in the Pacific territory. In the past three years, the above-named offics have installed complete the plant of the Truckee River General Electric Company, a transmission plant of 1500 kw capacity; that of the Keswick Electric Power Company, a plant of 2250 kw capacity, and supervised the first year's work of the Yuba Electric Company, from which the well-known Bay Counties Power Company has grown. Much minor work has also been done by the firm. While the greater portion of Mr. Hunt's time is absorbed by the two companies, of which he is general manager, he takes an active part in the work of the "Engineering Offices," the success of which is in no small degree due to his advice and supervision.

Mr. Hunt is essentially an engineer in all that the word implies, uniting sound judgment and technical knowledge with great capacity for detail and conscientious regard for the interests placed in his care. In addition, he is possessed of executive ability of a high order, as has been particularly demonstrated in his construction work at Los Angeles and San Francisco, and his work in Alaska. Mr. Hunt is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Society of Naval Engineers.

The Dalles, Oregon, Transmission Plant.

By Arthur Seufert.

THE beginning of the corporation which recently completed The Dalles 20,000-volt transmission plant goes back to Sept. 11, 1883, when the Wasco Warehouse Company was formed for the purpose of engaging in the wool business and in forwarding and storing general merchandise. In 1890 another corporation known as The Dalles Electric Light & Power Company, was formed for the purpose of furnishing light and power. In 1901 the above corporations were consolidated into the Wasco Warehouse Milling Company, having a capital stock of $300,000, and composed of leading business men and bankers. It having been decided to build a flouring mill at The Dalles of a capacity of 700 barrels a day, the question arose as to what to use for power. It was quickly decided that electric power was the most feasible, as within a few miles there are many undeveloped waterfalls, among which may be mentioned one at Hood River, 22 miles west; another at Klickatat River in Washington, 20 miles west; the Celilo Falls in the Columbia River, with a fall of 34 ft., about 12 miles east; the Des Chutes River, 18 miles east, and the White River, a branch of Des Chutes River, 27 miles south. After careful examination of all, the latter was decided to offer the most advantages, including lowest cost for development, and in 1901 a contract was let to the Pacific Bridge Company, of Portland, to develop the power and build the generating plant. Work was started in August, 1901, and the plant was to be completed before Nov. 15, 1901, but through unforeseen delays it was not ready for operation until Jan. 5, 1902.

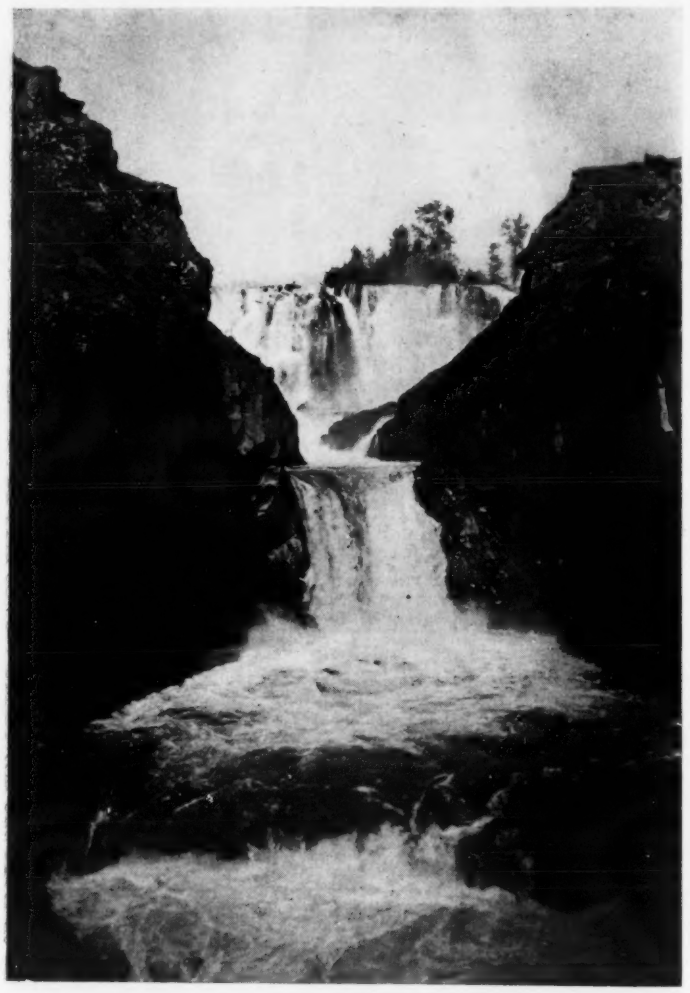


FIG. 1.—WHITE RIVER FALLS.

The plant is situated as a bird flies, 27 miles south of The Dalles at White River Falls in Wasco County, Oregon. There are two falls in the river at the head of the works, and the power station, which is of stone, 30 by 60 ft., is at the bottom of the second fall. The plant is placed 10 ft. above the level of the river, and utilizes a head of 131 ft., the 10 ft. insuring there will be no interference through freshets in the river. At the head of the falls there is a concrete dam 8 ft. high, from which the water is carried in a wooden flume 54 inches in diameter and 1200 ft. long laid with one foot fall to a hundred, and delivering a head of 119 ft. at the waterwheel pit. There are at present three waterwheels, two of which are direct connected to two three-phase 500-kw, 2300-volt generators, operating at 60 cycles, and of a current capacity of 126 amperes each. The other wheel is direct connected to a 30-kw exciter. This wheel is also in reserve for another generating machine in case business requires its output. The waterwheels were made by the Knight Waterwheel Company, of Sudder Creek, Calif., and the electrical apparatus by the General Electric Company. The current passes through three 400-kw step-up transformers of the air-blast type, in which its voltage is raised to 22,000. The transformers are connected in delta, and are cooled by air furnished by a blower, a second blower being held in reserve. There are three oil switches.

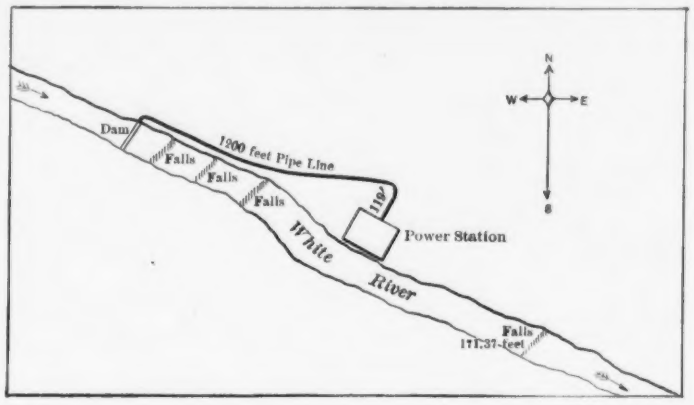


FIG. 2.—MAP SHOWING LOCATION OF PLANT.

The line is 27 miles long, and of No. 6 B. & S., bare copper wire on glass insulators. The conductors are transposed every mile. The main line poles are 35 ft. high, and those in The Dalles 60 ft. high, all being of cedar with 8-inch tops. There is a telephone line 6 ft. below the high-potential line, transposed every five poles. No inductive effect whatever has been noticed in telephone transmission.

The sub-station at The Dalles is built of brick, the dimensions being 27 by 45 ft. It contains three transformers, each of 375 kw, air-cooled under a pressure of ⅝ ounce by a blower, a second blower being held in reserve. The voltage is here reduced to 1100 for distribution. There is also one 35-light constant-current 6.6-ampere transformer. The high-potential switches are of the oil-break type, mounted in a brick vault. There are also two oil-break switches on the low-potential circuit.

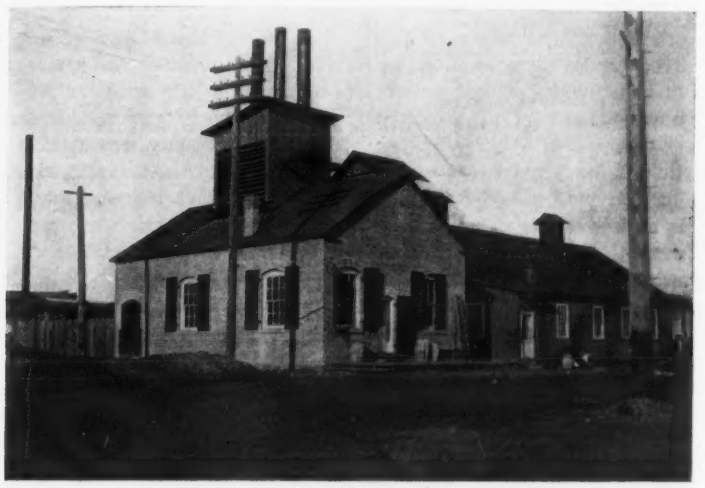


FIG. 3.—SUB-STATION, THE DALLES.

The 35-light transformer is for street lighting, the arc lamps used being of the enclosed type and of 1200 cp, all connected in series. The lamp takes about 72 volts at the arc.

The flouring mill has two induction motors, one of 200 hp and one of 50 hp, operating at 1040 volts. The larger motor runs the mill, and the smaller one operates the elevator. The city lighting circuit

has a voltage 1040 volts, which is stepped down to 104 volts for incandescent lighting.

The plant so far has given perfect satisfaction, and from all appearances will continue doing so. There is at present a surplus of 700 hp. Fig. 1 shows the White River Falls. The generating station is on the left side of the view, but does not show in the picture,

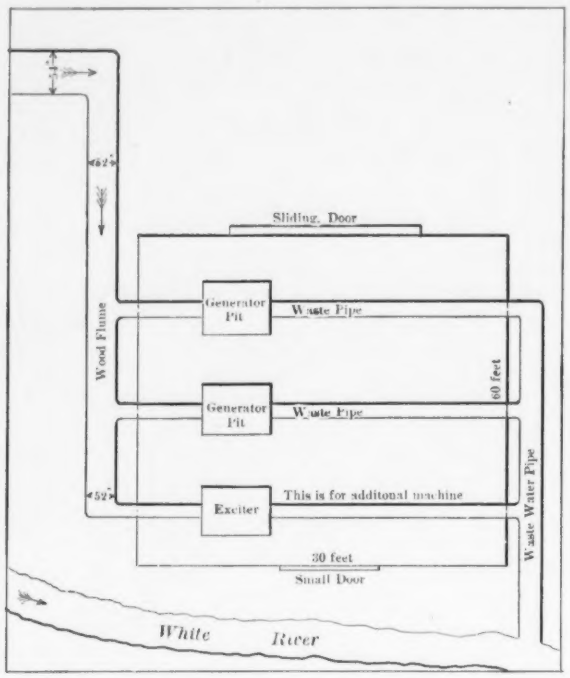


FIG. 4.—GENERAL PLAN OF THE POWER HOUSE.

as it is situated considerably below. Fig. 3 shows the sub-station at The Dalles. The chimney of the old steam plant which had to give way to the new one, is shown to the left.

Note on the Spectrum of the Enclosed Arc.

BY WM. LINCOLN SMITH.

ON page 195 of ELECTRICAL WORLD AND ENGINEER for Feb. 1, 1902, appears a brief article by Dr. Louis Bell upon the spectrum of the enclosed arc. Dr. Bell called my attention to this spectrum on the evening of the day upon which he observed it, and the brilliant character of the carbon bands interested me greatly. Being engaged upon a considerable piece of research work and having ready at hand a Konig spectrophotometer, it occurred to me that it would be interesting to examine the arc with that instrument, and see how the results would fit in with Dr. Bell's Knowing, however, of his intention to print his observation, I did not feel justified in printing an account of my measurements until his article had appeared.

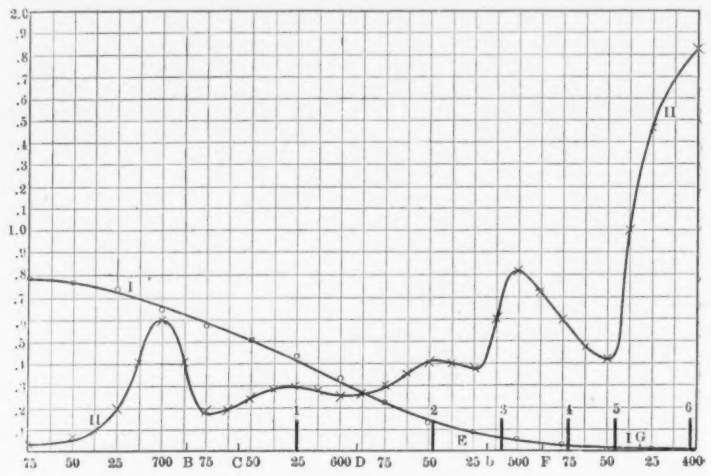
In the electrical laboratory of the Massachusetts Institute of Technology, where I was at work, were set up a number of enclosed arcs of various types convenient for the purpose at hand, and of these I selected a General Electric constant-current alternating lamp adjusted for 6.6 amperes, 70 volts at the arc and a frequency of 55. It was fitted with a light opal enclosing globe 3 inches by 6.5 inches, and a clear outer globe 11.5 inches by 12 inches; the carbons were ½ inch Electra, the upper solid and the lower cored. The lamp was running with several others on a constant-current transformer of the same company, fed from a large Mordey alternator carrying no other load, and the steadiness was excellent. As a comparison lamp, I used a 220-volt, three-glower Nernst lamp, sent me by Mr. A. J. Wurts. I had fitted this with a screen having a little window of the same opal glass as was used on the arc.

The accompanying chart will show the results obtained with clearness. Abscissæ are wave lengths and ordinates ratios of lamp under test to standard. The locations of several of the more important of the lines in the solar spectrum are indicated, and the heavy black lines indicate approximately the centers of the bands shown in the cut in Dr. Bell's article and are numbered to correspond.

Curve I. gives the ratios of the Nernst lamp to the clear overhead sky as determined on Jan. 27 at about 2.15 P. M. It had rained the day before and the sky had come out remarkably clear. The Nernst lamp with its screen was at a distance of 1 ft. from the slit of the instrument. It will be seen that under these conditions the intensity of the Nernst is about 0.8 that of the sky in the lower red and falls to about 0.01 in the region of the *G* line. I used the sky for reference because it seemed to me that it was a less variable thing than the sun itself, provided that it was not veiled with clouds and the sun was a reasonable distance above the horizon, especially when it had just cleared off after a rain.

Curve II. gives the ratios of the arc to the Nernst. The latter was again 1 ft. from the slit and the arc at 4 ft. delivering its light horizontally. Under these conditions the ratio of the arc to the Nernst at the *B* line is 0.4, and at the *G* line it is 1.3.

There are distinct maxima at abscissæ 700, 625, 550, 500 and 400. Of



SPECTRUM OF THE ENCLOSED ARC.

these the second, third and fifth coincide with Dr. Bell's first, second and sixth bands; the first lies wholly below his limit of the *B* line; the fourth is apparently due to the joint effect of his third and fourth bands, and there is none corresponding to his fifth band.

I was careful in taking readings to do so only when the arc was playing between the same points on the carbons, as nearly as one could judge, but some variation, of course, occurred, and may account for exception at band No. 5. At any rate, the curves are not without interest and show clearly enough why these arcs are so good photographically.

I would say in closing that the curves obtained from a 220-volt enclosed arc are something fearful and wonderful to see. They are not plotted here because of the widely different scale of ordinates required, the ratio at the *G* line being in this case 6.9, while at the *B* line it is only about 0,6. not very different from the one here shown.

Telephony in Arizona.

Great telephone development has been made in Arizona in the past year. There are now in the Territory 36 exchanges and public offices, with 1476 telephone connections. All of these stations are connected by toll lines. In the same time the Pacific States Telephone & Telegraph Company has erected 108 miles of copper toll lines, and has put in 712 new telephones. During the past 22 months the company has built 418 of long-distance toll lines in Arizona. A large gang of men is engaged at Tucson installing a new plant.

The Arizona system is as yet isolated to a degree, having no through connection outside of the Territory. As soon as material is available the company proposes to extend its line eastward from Redlands, Calif., to Phœnix, Arizona, via Yuma, thereby connecting the Arizona and the Pacific Coast systems. This will give patrons in the Territory through communication with Los Angeles, San Francisco and all the cities and towns of California, as well as opening to them Oregon and Washington as far north as the Canadian lines, and portions of Idaho, Utah and Nevada.

The company also proposes, within the coming year, to extend its main lines north from Jerome to Flagstaff, north from Florence to Globe, and east from Nogales to Bisbee, taking in intermediate points of importance. It is expected that on the completion of these extensions the Rocky Mountain Telephone Company will reach out to some point in Northern Arizona—probably Flagstaff—and establish a connection with its service.

The Effect of Electric Waves on the Human Brain.

BY A. FREDERICK COLLINS.

DURING the month of September I made a series of experiments, demonstrating that the brain cells of man and animals exhibit a marked "coherer" effect under the action of electric waves of the Hertzian order.

The encephalons employed ranged from those of mammals of the lower type represented in the feline family to the highest, typified in man. The purpose of arranging these tests was to verify, if possible, the casual observations long since made that approaching electrical storms manifested their presence in persons afflicted with certain forms of nervousness and other pathological conditions, though the storm influencing them might be many miles beyond, or even below, the horizon.

To accomplish this task it was necessary, of course, to decide conclusively that electric waves exercised some behavior or produced a change, molecular or otherwise, on the brain cells, and finding this premise true to then inquire into the nature of the phenomenon resulting from such action, and, finally, to ascertain the physiological consequences proceeding therefrom.

There are other maladies besides nervousness that are extremely susceptible to the disturbing atmospheric electrical agencies, and the two most common ones are gout and rheumatism.

Upon the barometric readings of an old gentleman I once know, who foretold approaching storms with an accuracy equal to the best meteriological apparatus by means of his "bad leg," as he called it, I formulated the opinion that the connection between the storms and his bodily self was real, in fact, as real as though he and his enemy were connected by a metallic conductor, though many seemed to believe, like Boscovitch and his followers, that the storm acted at a distance on his offending nether member without the aid of intervening matter to convey the impressions, or as Lord Kelvin tersely puts it, "that matter can act where it is not." This solution was as widely divergent from the truth as that confessed by the most ignorant who attributed his prophesies to some supernatural agency.

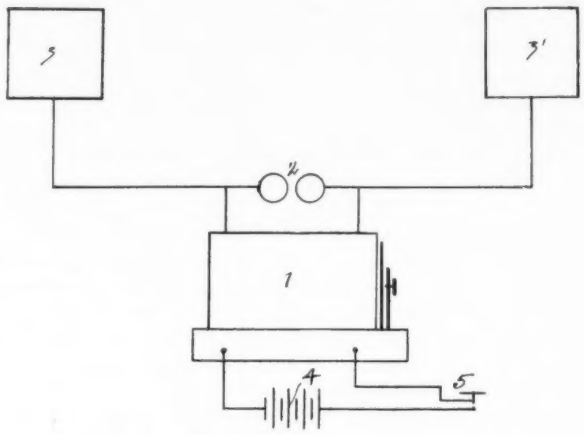


FIG. 1.—DIAGRAM OF WAVE-EMITTING APPARATUS.

After observing the case just cited, I studied many similar ones, some less marked, others more serious, and finally one came under my notice that had a tragic ending.

A little girl of eight years, residing in Germantown, a suburb of Philadelphia, during the month of August became *apparently* frightened as the heavy disruptive discharges of an electrical storm approached, and as the terrific crashes sounded simultaneously with the flashes she was thrown into convulsions, and when a moment later the lightning struck a house a quarter of a mile distant, the child expired. Now see: it was not the lightning that killed the child, and, in my opinion, it was not fright, but a deeper, far more subtle agency, and in this there is food for thought. The coroner did his duty in returning the verdict that her death was caused by "shock and convulsions, due to fright." On the surface of the post-mortem and in view of the fact that at the time nothing was known absolutely concerning the action of electric waves on brain matter, his statement was perfectly justifiable. The daily papers said the child was suffering from heart trouble, but this I ascertained was incorrect. I then formed the hypothesis that, not only in this, but in every case the waves acted on the brain cells first and the other physiological effects followed as a natural sequence, and I believed then, before I made the tests, as I do now, that the fright exhibited by this little girl was only an outward physical expression of the change registered by the cells, and that the real cause could be logically attributed to the preculiarly strained tension of the brain matter, and that death was the secondary product of this result.

The experiments of Herr Heinrich Hertz, which lead to his discovery of stationary electrical waves as are those of M. Edward Branly on the effects of the Hertzian waves acting on the variable contacts formed by filings of metals so well known that they need not be repeated here. Suffice it for me to say that I merely carried out the theory and practice of Hertz and extended the researches of Branly on the action of electric waves to the realm of physiological matter.

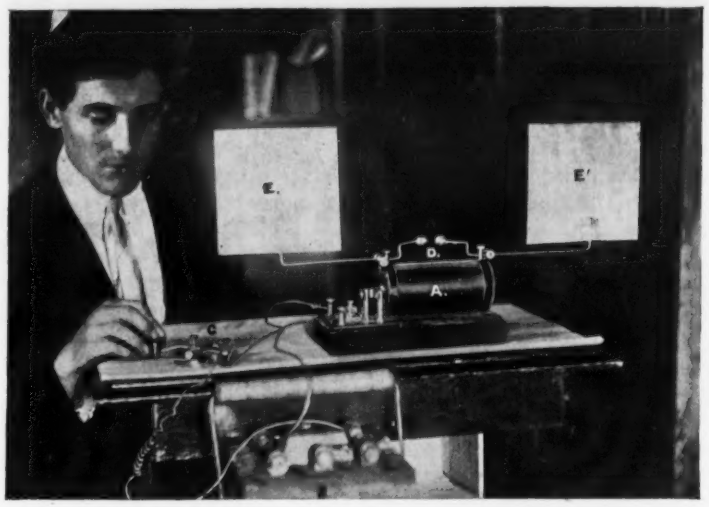


FIG. 2.—APPARATUS EMPLOYED TO SEND OUT WAVES.

The apparatus I employed for emitting the waves was similar to that designed and used by Hertz in his later experiments wherein he used a coil of small proportions. Mine was somewhat smaller, giving a 2-cm. spark, and was constructed by Queen & Co., of Philadelphia. Fig. 1 shows the general arrangement of the oscillator, spark-gap, battery and key; 1 is a Ruhmkorff coil with the ordinary mechanical interrupter, 2 the spark-gap formed of two brass balls 12 mm. in diameter, and connected with the terminals of the secondary, as shown, and directly joined to the terminals of the secondary are the capacity areas 3 and 3', made of sheet zinc 1 mm. in thickness, and its other dimensions measuring 14 cm. each. This arrangement gave, when the waves were reflected by metal mirrors to effect interference, wave lengths of approximately 30 cm.

To the primary coil a storage battery 4 supplied the energy and the current from this could be arbitrarily made and broken by means of the key 5.

The photograph (Fig. 2) shows the apparatus in operation, in which *A* is the coil, *B* the battery, *C* the key, *D* the spark-gap and *E*, *E'* the capacity areas forming the oscillating system of the disruptive discharge. By means of the detector apparatus shown in the diagrammatic drawing (Fig. 3), I was enabled to determine that the brain matter, when subjected to the radiations of the emitting apparatus produced a "coherer" effect, i. e., a change in the normal resistance. This apparatus consisted simply of two dry cells *A* connected in series with a telephone receiver *D*, although this was occasionally substituted for a galvanometer of the d'Arsonval type, the

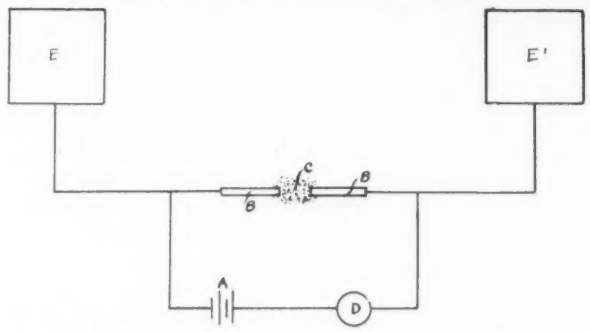


FIG. 3.—DIAGRAM OF ELECTRIC-WAVE RECEIVING APPARATUS.

coherer plugs *B* and *B'*, the brain cells are, in the drawing represented by the dots *C*. While no attempt at "tuning" was made, the zinc plates *E, E'* forming capacities, of the same shape and size as those of the emitter system, were employed in nearly all the experiments, although sometimes they were omitted.

In the first test I obtained from my butcher the brain of a freshly killed mammal. Into this mass, so unlike the human brain, I inserted two glass armored needles at a distance one from the other of 4 cm, and found that the inert assemblage of dead cells offered a tremendous resistance to the current from the two-cell battery, and I also noted that the effect of electric radiation was *nil*. While the test was disappointing, still the outlook was encouraging, since the results coincided with the action of the waves on loose metal filings, as in the early experiences of Calzecchi. I bethought me to cut down the distance between the needles, and these were then inserted into the brain, devoid of form or convolution at a distance of 1 mm. apart, and crudely adjusted until the telephone told me the resistance was not too great. Now, the key was pressed again, and as the disruptive discharge oscillated to and fro, emitting electric waves of great frequency, the characteristic sounds of cohesion could be distinctly heard in the receiver, almost exactly as when the standard carbon coherer (Fig. 4A) was inserted instead of the brain.

Here the keynote had been struck, and the results obtained offered something more than a mere incidental phenomenon to be wondered at and forgotten. In the above statement I mentioned that the sound audible in the telephone receiver caused by the cohering brain cells and that produced by granular carbon were similar, and that both are characteristic. Now, carbon granules, be it known, when subjected to the radiation of electric waves, cohere only while the waves are acting upon it, but immediately the influence is removed or even weakened, the particles de-cohere, or in the terminology adopted by those engaged in wireless telegraphy it is self-restoring or "self-righting," which means that without tapping or other extraneous means the particles de-cohere. For this reason I chose the type of coherer shown in Fig. 4A as the standard, with which to compare the subsequent results obtained with the brain matter.

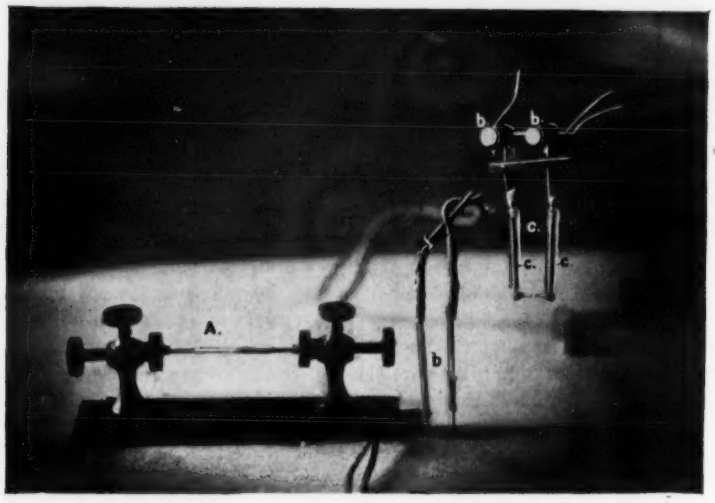


FIG. 4.—COHERERS USED IN BRAIN TESTS.

The brains from the abattoir, though fresh in the sense that decomposition had not set in, were two or three hours old, and it seemed to me that the experiment should be tried upon a brain immediately it was removed from the cranium.

With this idea in view, I laid the results obtained as well as the object of the tests, together with my plans and hopes, before Dr. Rotzell, lecturer on zoology and anthropology of the Hahnemann Medical College, of Philadelphia, and who resides near me in Narberth, and with his approval and co-operation I was able, the following morning, to operate on the brain of a feline in my laboratory within 30 minutes after respiration had ceased and the heart had stopped beating. In these experiments I was assisted by Mr. Warner, a third-year medical student. The brain was removed from the cat's skull at the doctor's place and transferred to mine in a vessel containing water. The tests were not as satisfactory as the previous ones, but this was probably due to the surface moisture short circuiting the local battery current.

However, the sounds of cohesion were distinct enough to warrant varying the tests, and we decided upon some control experiments. These were performed within a few days, and there were present Dr. Rotzell, Mr. Charles B. E. Taylor, of Germantown, and myself.

Another cat, under the influence of an anæsthetic, willingly lent itself to the subject for the investigations to be made on brain matter in the living state. The doctor made an incision with his scalpel extending the length of the frontal bone and at right angles to it. Laying the skin back the cranium was exposed; two holes, 1 mm. apart, were carefully drilled through the frontal. These were 5-10 mm. in diameter, and the depth so gauged that even the *dura mater*, or outer membranous lining separating the brain from the bone, was not disturbed. The needles were now inserted—these representing the coherer plugs—and the key of the wave emitting apparatus was closed at intervals of one-half second. The sounds of cohesion were decisive, especially after the serum was dried away with absorbent cotton. When the key was opened the brain regained its normally high resistance like the carbon granules of the standard coherer.

Varying distances between the dissecting table on which the cat lay and the wave-emitting apparatus was arranged and tried, but within the small confines of the laboratory no position could be obtained where the brain was not subject to the waves.

While the table was being moved about, the key of the emitter apparatus became accidentally closed and a flood of electric radiations went forth, which, had they been of the visible instead of the invisible spectrum, they would have filled the room with light. Mr. Taylor was at this moment administering more ether to the cat, for it showed evidence of awakening. Grasping its spinal column just below the *medulla* with his left hand he held in his right the cone containing the etherized cotton. Anæsthesia was quickly accomplished. Mr. Taylor then called my attention to a vibrating movement at the base of the brain, when both Dr. Rotzell and myself noted in turn the phenomenon. There was a spasmodic twitching of the muscles just as a Du Bois-Reymond or "shocking" coil would produce. When the electric waves were intercepted or cut off the muscles regained their normal tension. After consultation, in which Dr. Rotzell represented the case in its physiological aspect, Mr. Taylor as arbiter and myself in the capacity of electrician, we came to the conclusion that the manifestation was the result of the following causes:

It is well known that there is no apparent physiological effect from a direct current of small amperage and low voltage, except, as Du Bois-Reymond has shown, when the current begins to flow and when it ceases to flow, or upon the make-and-break of a very feeble current an excitability of the nerves produce results analogous if not exactly identical to those which took place. In a carbon coherer, where the granules are under pressure, the resistivity and conductivity will increase alternately, while the waves may be emitted constantly. This increase and decrease in effectiveness of the waves is, very likely, due to the oscillations of the discharge, the first swings producing waves of much greater energy than the final swings which are damped down until they reach zero.

In the phenomenon under investigation this is what evidently took place. The brain cells cohere with the waves emitted by the first few oscillations, and then de-cohere to a certain appreciable extent, when the waves were enfeebled by the last few oscillations, as the discharge was restoring the potential between the secondary terminals of the induction coil. This process, it seemed to me, acted as a make-and-break of very great rapidity, and so gave rise to the electro-nervous excitability and its attendant muscular action. This seems much more reasonable than the theory that the direct action of the waves themselves exerted this influence, although it would be easier to reconcile this latter hypothesis with the one offered in advocating the cause and effect of the waves on living brain matter advanced in the beginning of this argument. The solution of the problem is to be found in assuming that the e. m. f. of the battery is replaced in life by nerve force, with which it is often compared. It is true the cat was alive, but there is no doubt that the nerve force is greatly nullified by the administered anæsthetic. While these are yet theories to be sifted by further experiment, the fact is clearly established that electric waves act on and cohere brain matter not only after the change in it by death, but also *while it is in the living state.*

Having demonstrated this, it follows in logical sequence that the same effects would be apparent in the human brain, though there is considerable difference in the formation of the cells as well as in mass of the brain of man when compared with the lower animals.

To experiment with a living human brain under the conditions ob-

tained with the cat is, of course, impossible, or nearly so, but it is not impossible, however difficult to procure a human brain immediately after the death of its physical affinity—the body.

Upon the advice of Dr. H. L. Prince, the well-known pathologist of Philadelphia, I designed a coherer especially for the purpose of obtaining accuracy of adjustment, which was not possible with the armored needles previously used.

It is shown in detail in the drawing (Fig. 5), and in perspective in the photograph (Fig. 4*c*). As the illustrations show it is formed with parallel legs of sufficient length to permit the contact points *a, a'* to be sunk into any portion of the brain. The points are 5-10 mm. in diameter and 2 mm. long, hard soldered at right angles to the brass legs *d, d'*, and these in turn are securely attached to the brass levers *j, j'*, which are fitted with binding posts 6, 6'. Through the orifices of the binding posts slides the wire *K*, having a thread cut on the right-hand end. A milled screw thereon gives a micrometer adjustment between the two platinum terminals, *a* and *a'*. The bar *e*,

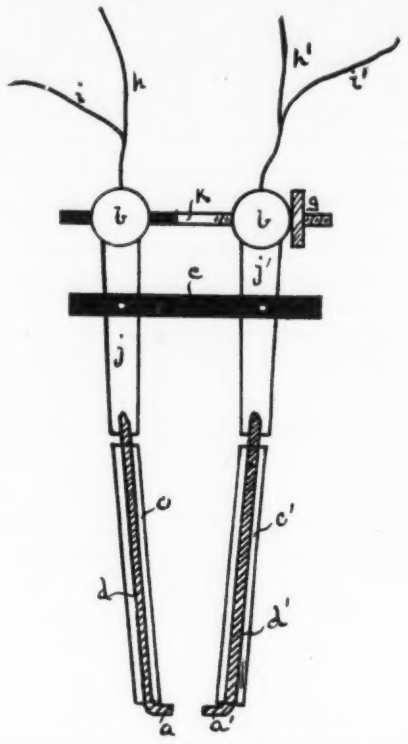


FIG. 5.—SPECIAL DESIGN OF COHERER FOR BRAIN EXPERIMENTS.

the inserted pins of which form the fulcrum of the levers *j, j'* and *d, d'* is a piece of hard rubber. The brass legs *d, d'* are protected with armors of glass tubing sealed at the top and bottom. The wires *h, h'* lead to the resonator plates when they were used, and the sub-terminals *j* and *j'* to the telephone receiver or galvanometer and to the battery, as shown in the diagram (Fig. 3). With the details of these simple apparatii in mind, let us turn to the human brain. A brain, when death has eliminated its spiritual affinity from the grosser physical form, is of little worth to any one, except the anatomist. The beautiful psychological functions of the brain can be better studied when it and the body it represents are endowed with that indescribable life principle. Yet, clay though this wonderful organ is in death, it is a most difficult object to obtain. A brain prepared for the anatomist could not, it is indisputable, be employed in the succeeding tests, for if treated with formalin or any other preservative it would represent no longer its original elementary parts, but a combination of extraneous chemicals with it, and our tests with electric waves would be valueless. None but a fresh brain could be used if accuracy is aimed at. That the nature of the experiments may be the better understood, it may be well to say something of the anatomy of the brain itself.

The human brain or encephalon is the central axis of the nervous system, and through it the physiological machinery responds. The spinal cord is connected with the brain at its base, and from these two great centers branch the nerves in every direction. Fig. 6 shows a cross section of the brain. The *medulla,* 1, is an uninterrupted portion of the spinal column; the *cerebellum,* 2, lies directly behind the *medulla* and a little above, and is continuous with it. The *pons,* 3, lies above and in front of the *medulla,* and likewise continuous with it; the *cerebrum,* 4, is the larger mass above the *pons* and *cerebellum,* with both of which it is directly connected. Without entering into a detailed anatomical description of the various parts it will be necessary to describe them broadly inasmuch as the phenomenon forming the subject matter of this statement, and the brain are closely allied.

The brain and other portions of the nervous system are composed of two kinds of homogeneous tissue known as gray and white matter. There are occasionally minute masses of gray matter in isolated places, and this is called *ganglia.* This is the active element, and apparently the source of nervous force, or if the analogy is permissible, the battery supplying the vital principle. The white matter composes the fibers or nerve tracts for transmitting the impressions, the conductors by which the nerve force sends and receives its messages.

The *medulla* is made up of two parts, and these are subdivided into elongated fibers composed chiefly of nerves. The gray matter of the *medulla* contains many nerve cells, and in it originate several important brain nerves. The *pons varolii,* or bridge, like the other portions, consists of gray cellular matter, and the fibrous white matter, the latter passing through the *pons,* both transversely and longitudinally. These cross directional nerves connects the hemispheres of the *cerebellum,* so that they are virtually continuous with each other. Those parallel with the length of the *pons* arise from the *medulla,* and those entering the *pons,* emerge from it at the surface nearest the *cerbrum.* The *cerebellum,* or little brain, is divided into two hemispheres and a central lobe. On cross section the *cerebellum* presents a tree-like appearance. It is connected to the *cerebrum* above and to the *medulla* below by nerve fibers. The external surface of the *cerebellum* is apparently sub-divided into numerous thin plates caused by fissures, thus giving it the appearance of laminæ. Both white and gray matter are present, the first forming the cortex of the laminations and the latter branching off from a common center to the exterior. *Ganglia* are also found in the interior of the organ. It is claimed that the auditory nerve as well as the sensory roots of the fifth cranial nerve are of *cerebellar* origin.

The gray matter of the exterior surface of the *cerebellum* is separated into two layers, the outward of gray and the inner of a rust color containing granules and invested by protoplasm or microscopic cells.

The *cerebrum,* or great brain, is marked in the human anatomy with prominent convolutions upon its surface and comprises six-sevenths of the entire brain. From the *pons* two white fibrous bands enter the hemispheres on either side. The optic nerves find their origin in the nervous tracts of matter which converge in front. The cortex of the *cerebrum* is of gray matter, and upon horizontal dissection the gray matter of each convolution is found to have a core of white matter. Lateral cross-section shows five or more strata,

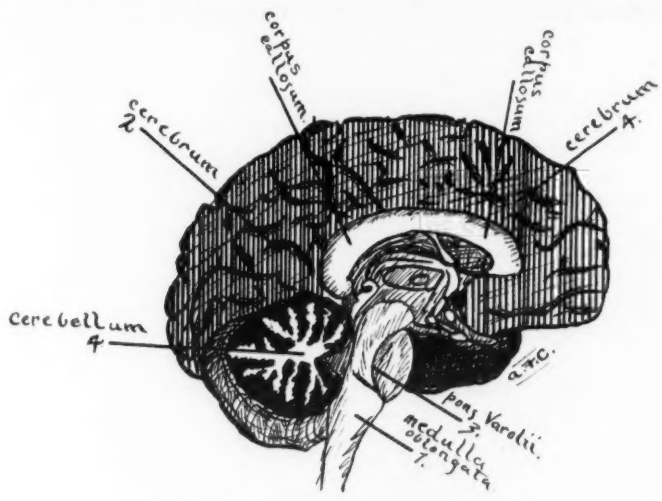


FIG. 6.—CROSS SECTION OF HUMAN BRAIN.

and these in turn are composed of pyramidal nerve cells, of nerve fibers, of matrix and blood vessels.

Closely allied with the nerve cells are minute nerve corpuscles and fusiform cells are found imbedded in the lower layers of the gray matter. These general notes on the brain will suffice to make clear the following observations of electric wave action upon it.

On a certain afternoon a magnificent specimen of a human brain came into my possession immediately after its removal from the cranium, and within a few hours after the death of the physical body. It weighed 1250 grams. Here the individual convolutions were

in marked contrast with those of the lower animals, and every part was developed to a high degree. Upon reaching my laboratory the brain was placed on a glass insulating slab, and its electrical resistance measured. The needles were inserted in either hemisphere of the *cerebrum* at a distance 8 cm., and to a depth sufficient to obtain good contact without reaching the white matter. With a Wheatstone bridge it was ascertained that the resistance was normally over 5000 ohms, which, when Ohm's law is taken into consideration, is a very high value. The coherer was then adjusted as well as the emitter apparatus, and I made a number of tests to determine what special portion, if any, was most sensitive to the effects of the radiation. First the coherer was inserted into one hemisphere of the *cerebrum* to a depth of 2 or 3 mm., so that contact was made with the gray matter only. Fig. 6 shows the arrangement of the coherer relative to the brain in the test just mentioned. The result was similar to those previously obtained in the lower animals. Slicing a horizontal portion from the upper part of the hemisphere, the coherer was next inserted in the mass of white matter forming the core. The sound of cohesion was less marked than in the previous test with the gray matter. Different portions of the white and gray matter were tried, but with similar results. The *medulla oblongata* did not yield results as satisfactory as the gray matter of the convolutions of the *cerebrum*. There was little difference between the calculations of the *cerebrum*, and the white and gray matter of the *pons*. The different layers of the *cerebellum* were next tried, but the rust-colored layer containing the granules produced the greatest coherer effect, while in the *medulla*, where the nerves center, the effect of the electric waves was less marked than in the other portions of the brain. All the above tests were made with the brain intact, except where it was necessary to operate on an interior portion, when dissection was resorted to. The calculations thus obtained were made on the day the brain came into my possession. On concluding, I immersed the inert mass in a 6-10 of 1 per cent solution of chloride of sodium, this representing very closely the natural alkaline solution, not only of the cerebral cavities, but the physiological body as well; surrounding the first vessel was a second containing ice. The purpose of this solution was to preserve the brain with as little recourse to artifice as possible. The following day there was no appreciable deterioration. Now, instead of employing the special coherer I used the standard coherer shown at *A* (Fig. 4). After removing the carbon I then inserted in the glass tube minute masses of the gray and white matter of the *cerebrum*, of the *cerebellum*, *pons*, and the *medulla*, as well as the granules of the rust-colored layer of the *cerebellum*, and then the coherer plugs were oppositely adjusted by means of screws, the brain matter taking the place of the ordinary carbon powder in the coherer. The action was more marked when a slight pressure was brought to bear on the brain matter, but as in metal filings it was *nil* when too much pressure was applied, and if considerable pressure was applied the cellular matter became semi-liquid. As in the preceding trials with the brain in its entirety the granules of the rust colored layer proved the most sensitive. In the brain, when examined under the microscope, these granules consist of well defined nucleus invested by delicately branched protoplasms.

The cross sections of the brain matter used in the coherer tube were accurately measured, and were 1 mm. in diameter and 1 mm. in length, and the resistance of varying portions was from 5000 to 11,000 ohms, although this divergence was, very likely, due to the difference in pressure applied by the coherer plugs, and not to the structural difference of the parts compared.

In conclusion, I intended to once more measure the resistance of the brain as a whole to ascertain if possible the relative differences in electrical resistivity the deterioration 24 hours would produce. The needles were inserted in the opposite hemispheres of the brain, as previously described, and connected with the terminals of a Queen testing set. It was with some astonishment I found I could not balance the bridge arms. After an approximate balance the needle suddenly swung to + without apparent cause, showing hundreds of ohms too much, and an immediate second deflection to the — showing hundreds of ohms too little, without the removal or insertion of a plug. This state continued a few minutes, when a peal of thunder awakened me to the actual cause. A storm was approaching. The battery and galvanometer key was held in contact every alternate second at one second intervals, and as the storm approached the deflections grew more and more pronounced, the needle quivering at either end of the scale alternately, as though endowed with life. The very phenomenon I sought to verify with a 2 cm. spark coil was here produced by the lightning itself. I placed the needles closer together in the *cerebrum*, and the deflections of the needle gave an absolute demonstration of the energy transmitted by the electric waves from the lightning.

To exclude the probability of the waves acting on the galvanometer system I measured a 1-ohm coil, and in this no difficulty was encountered. When the storm was at its height I substituted a telephone receiver for the testing set (Fig. 7), and through it and the medium of the brain came three sounds like the cooling of a piece of red-hot metal quickly submerged in water. Lightning had struck a house a quarter of a mile away, down in the valley of Narberth, ripping the slate roofing from the cupola. In these tests I was favored with circumstances, which, with me, might never occur again, for the reason that a fresh human brain was necessary, and that an electrical storm should be in progress when all was in readiness was quite remarkable.

The summation of the results showed that the gray matter, which is the source of active force, is more susceptible than the white tracts consisting of the nerves or conductors of the impressions, and that the granules of the rust-colored layer is the most sensitive of any portion examined. Just why this should be so is hard to state, since the gray matter of the *cerebrum* evidently performs the functions of the mind and by its offices we are conscious of sensations; it would seem, then, that the electric waves acting on this part would be transmitted to the diseased portions of the anatomy. Oppositely, the functions of the *cerebellum* appear to act as a kind of governor in steadying the movements of the muscles and electric waves in cohering the cellular tissue, must certainly aggravate any previously existing disorders. Then, again, the waves may, and probably do, affect not only each individual differently, but also in individuals different portions of the brain. In the realm of theory let us suppose,

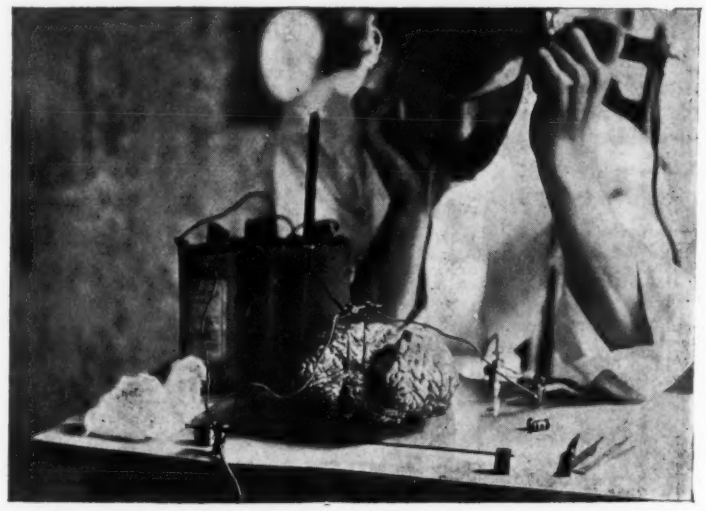


FIG. 7.—LISTENING TO COHESION OF HUMAN BRAIN UNDER ACTION OF ELECTRIC WAVES.

as, for instance, where the waves caused the death of the child, that the *medulla oblongata* was the most susceptible, it is not difficult to understand how death could ensue if cohesion was great enough or why the outward physical expression took on the aspect of fear, for in the *medulla* originate nerves that are absolutely essential to life and affect directly the face, throat, neck, heart, lungs and stomach.

From the foregoing results, I have tried to establish these facts (1) that electric waves emitted by lightning produce cohesion of the brain cells; (2) that cohesion takes place in brain matter when in the living state as well as immediately succeeding death; (3) that cohesion of the brain is manifested physiologically through the nervous system and not by direct action; (4) that which is often defined as fear is due to the action of electric waves on the brain; (5) that the brain cells are more violently affected than the brain fibers; (6) that this condition prevails when the brain cells or the nervous system or both are in a state of disorder, and, finally, (7) that the long electrical waves propagated by the disruptive discharge of lightning may produce distinct symptoms, and which may, under certain conditions result in death.

It is my intention to test the effect of the waves on the brain and auxiliary nervous system in its physiological aspect; in the tests just cited I have only attempted the primary anatomical ones. These may serve as stepping stones to psychological, physiological and pathological investigations of a similar character which it is to be hoped experts in these various specialized lines will be encouraged to take up.

The Debt of Electrical Engineering to C. E. L. Brown—X.

By B. A. Behrend.

200-HP SLOW-SPEED MOTOR.

FIGS. 62 and 63 are a photograph and a drawing of a 200-hp, three-phase motor for 50 cycles and 125 r. p. m. The motor is wound in delta for 4000 volts. The diameter of the rotor is 2700 mm., the bore of the stator being 2704 mm. It was necessary to keep the diameter small on account of lack of space. The magnetic circuit of the motor is very carefully proportioned, and thus a maximum power factor of 83.5 per cent has been obtained. Anybody who knows something about induction motor design will consider this result very good indeed. Fig. 64 shows the performance curve of the motor.

The short-circuit mechanism of this motor is novel and interesting. The annular spiral springs are moved parallel to the shaft and produce a contact all around the rings. This construction was devised by Mr. Aichele in charge of Mr. Brown's testing room.

SINGLE-PHASE INDUCTION MOTORS.

In 1892 Mr. Brown devoted his energies to the development of the single-phase induction motor, and he was the first to create a commercial type. We show a curve of a small early single-phase motor in Fig. 65, and it is not to be wondered at that after such success he enthusiastically advocated single-phase currents for the City of Frankfort. He who makes good polyphase motors is apt to know something about single-phase motors.

Mr. Brown started his motors as split-phase motors, using a water condenser as illustrated by Fig. 66 in the auxiliary phase. This condenser is generally in parallel to the auxiliary phase, which latter has twice as many turns as the main phase, and is in series to it. With this arrangement fairly good results for starting under load are obtained, but, of course, no single-phase motor is very satisfactory in this respect.

POLYPHASE RAILWAYS.

In 1894 Mr. Brown proposed to build, and soon afterwards did build in Lugano, Switzerland, the first three-phase surface railroad ever made. Then followed his railway upon the Gorner Grat near Zermatt, his locomotives for the Jungfrau Railway, and finally his trunk railway between Burgdorf and Thun. Pioneer as Mr. Brown had been in the design of alternating-current machinery, so he has been pioneer in its applications. The Lugano street railway has been a complete success. The Gorner Grat enterprise and its unquestionable success gave rise to the largest undertaking, the Burgdorf-Thun Railway. We have already given in Fig. 38 a view of the Kander station in which four 900-hp direct-connected generators supply by means of step-up transformers 16,000 volts to the lines. The line pressure is between 600 and 800 volts. We give in Fig. 67 an outline sketch of the 60-hp motors, four of which are mounted on a car, two on each swivel truck. A heavy freight locomotive is equipped with two 150-hp motors, which are shown in Fig. 68.

Mr. Brown writes about the 60-hp motors: "After seven months working we were told by the railway company's officials that none of the motors had ever been opened. On hearing this we sent a man to inspect the motors, as we wished to ascertain the state of the motors inside. The man reported that the interior of the motors showed absolutely no signs of wear and looked altogether as though the motors had done no work at all. Just compare this result with continuous current practice. This is also confirmed by the fact that since the opening of the line in July, 1899, we have never had to re-

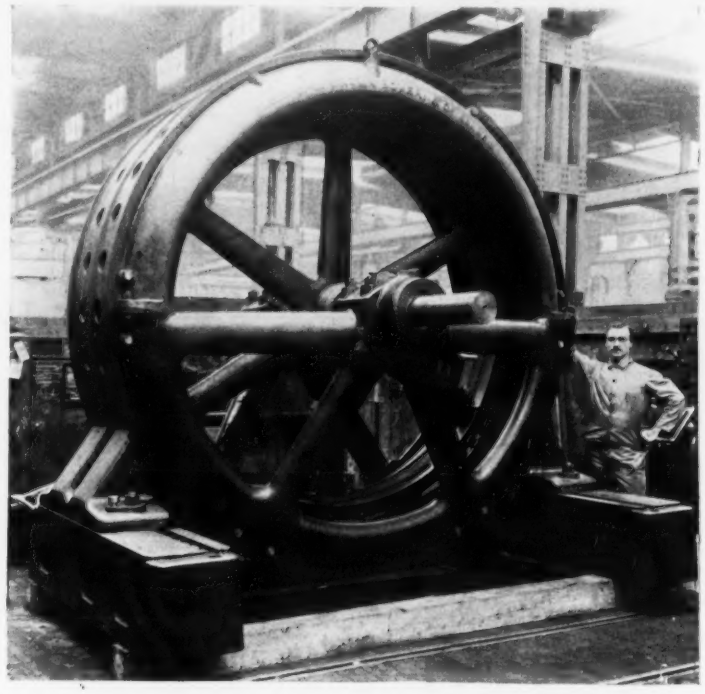


FIG. 62.—200-HP INDUCTION MOTOR, 125 R. P. M., 50 CYCLES.

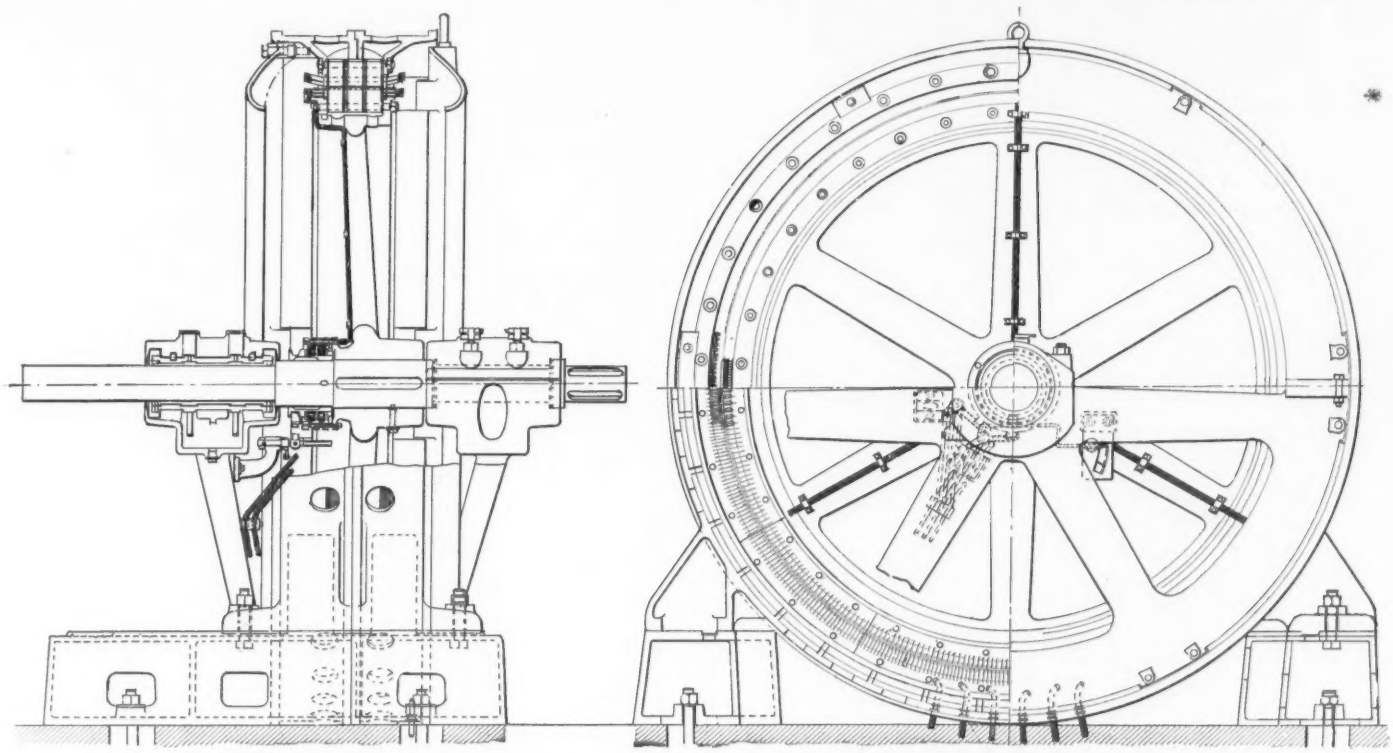


FIG. 63.—200-HP INDUCTION MOTOR, 125 R. P. M., 50 CYCLES.

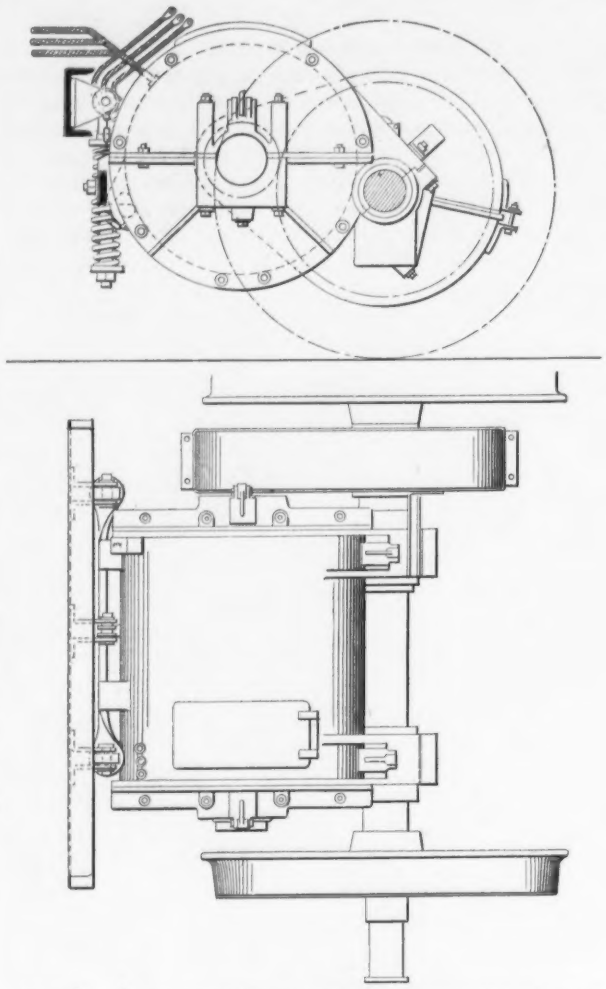


FIG. 67.—60-HP INDUCTION MOTORS FOR BURGDORF-THUN RAILWAY.

FIG. 66.—WATER CONDENSER FOR STARTING SINGLE-PHASE MOTORS.

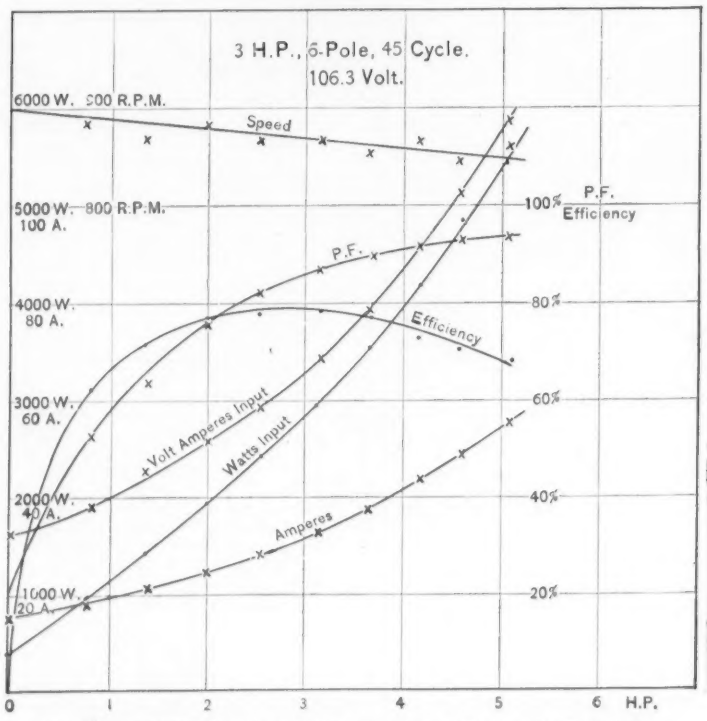


FIG. 65.—PERFORMANCE CURVES OF 3-HP SINGLE-PHASE MOTOR.

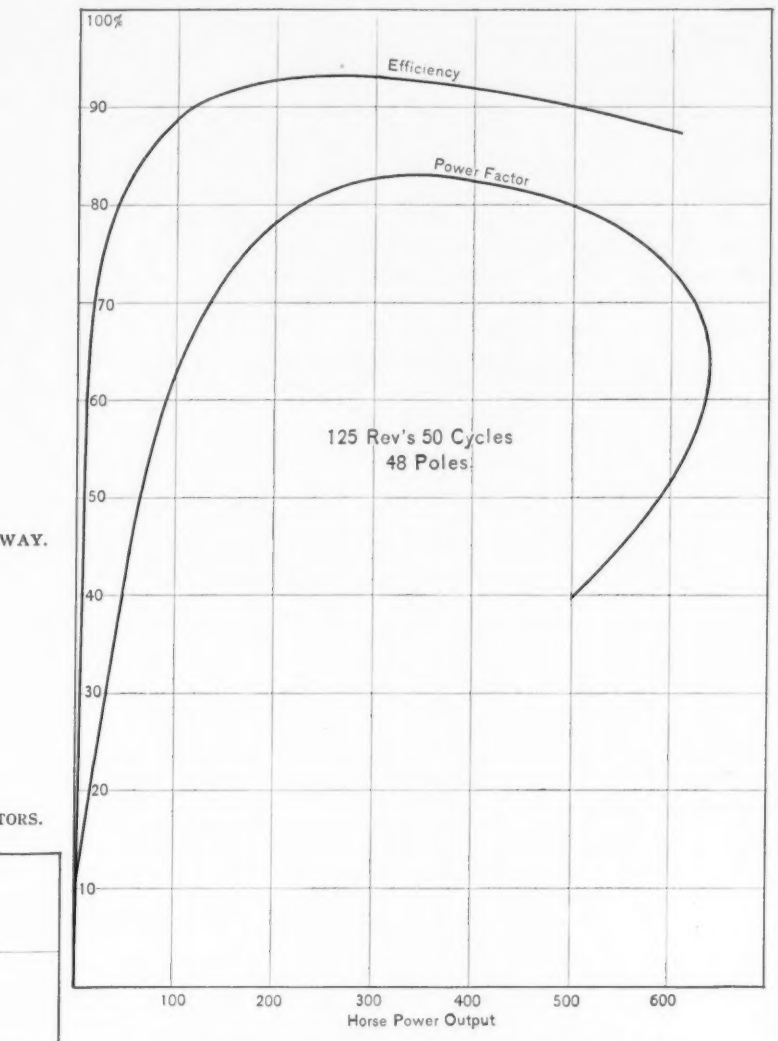


FIG. 64.—PERFORMANCE CURVES OF 200-HP INDUCTION MOTOR.

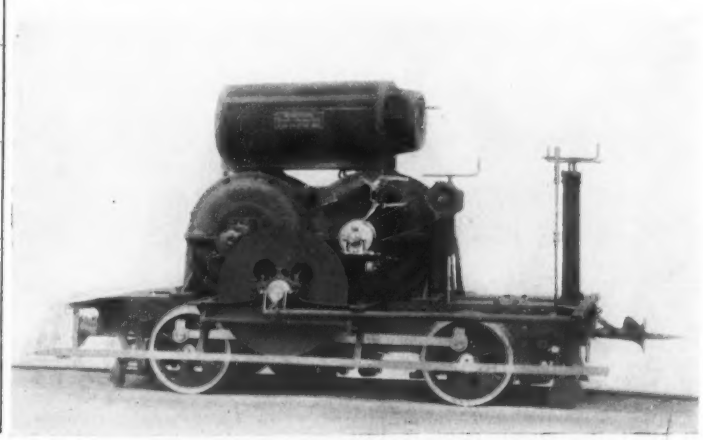


FIG. 69.—BROWN'S LOCOMOTIVE FOR JUNGFRAU RAILWAY.

pair any of the motors. Now, after two years' service with 24 motors the following results can be reported:

"Not a single fault occurred in either stator or rotor windings of any of the motors. The contact rings showed practically no wear. The same carbon brushes are in use as at the start. The ring lubrication has given perfect satisfaction, and no bearing bushings have had to be replaced. The only interruption to speak of was caused by the failure of a split ring, which locked a nut on the large sprocket-wheel of the gearing. This nut worked loose and fell into the gearing."

Fig. 69 shows one of the first two locomotives as built by Brown for the Jungfrau Railway. The rumor had been spread that, as the later locomotives had been built by the Oerlikon Company, the first locomotives had not given satisfaction. Though the Oerlikon locomotives contain some novel features and improvements, it must be borne in mind that Mr. Brown's locomotives had been the first in the field, and had become typical when the Oerlikon locomotives were constructed. Both companies' locomotives have given entire satisfaction.

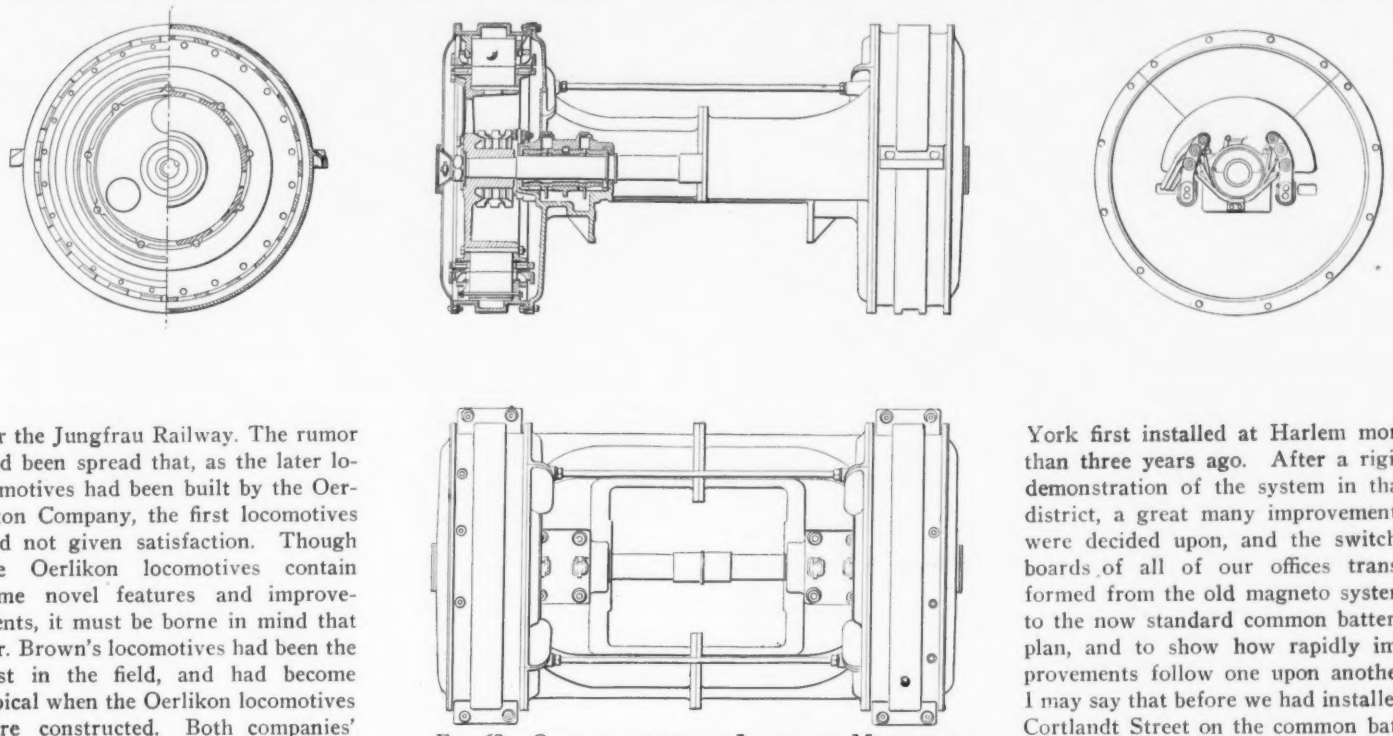


FIG. 68.—OUTLINE OF 150-HP INDUCTION MOTORS FOR FREIGHT LOCOMOTIVE.

Mr. V. Hegner, president of the Jungfrau Railway, writes that the "locomotives I. and II. built by Brown, Boveri & Co., have been in operation since 1898. They weigh about 30,000 lbs., and they take 230 to 250 amperes at 500 volts on a gradient of 25 per cent. They are very simple in construction, and they have proved reliable and safe."

Features of Modern Telephone Work.

The New York Electrical Society held a most successful and interesting meeting on Feb. 13 at the new Cortlandt Street exchange of the New York Telephone Company. Some 250 members were present. Before inspecting the exchange the society held a brief meeting, when Secretary Guy announced the name of 32 candidates, who were duly elected, and President Williams reported the society to be in excellent shape. It was a pleasant coincidence that the meeting was held on the same day of the month when the first circular in regard to it was issued in 1881. In the enforced absence of Mr. U. N. Bethell, the general manager, the society was welcomed by Mr. J. J. Carty, chief engineer, who said:

During the history of the New York Electrical Society, this is the second time which it has been my privilege to receive the society at this building and to exhibit and describe to it the central office telephone apparatus which it contains. It is almost exactly 10 years ago that the society met in this building for the purpose of inspecting its telephone installation. Ten years ago, as well as to-night, the Cortlandt Street plant was of sufficient novelty, magnitude and merit to warrant a visit from such a distinguished society as yours. But within these 10 years radical improvements have been made, changes have taken place, and an almost complete transformation has been effected. Therefore, before undertaking to sketch for your information an outline of the main features of the plant which it is my pleasure to exhibit to you to-night, it will be interesting and possibly instructive if I should first call your attention to some of the important advances in telephony which have been made in this country, and in this city during the last 10 years, all of which are embodied in what you are to see to-night, and when you view with the critical eye of experts that which is to be exhibited I am sure that your feeling will be that in the phenomenal advance in industrial affairs which has been made by Americans, that electrical developments are in the front rank, and that among these electrical developments the art of telephony has not lagged.

The opening of the present Cortlandt Street central office was but the culmination of a series of works planned a number of years ago and but recently completed. The common battery system, of which the Cortlandt Street office represents the highest type, was in New York first installed at Harlem more than three years ago. After a rigid demonstration of the system in that district, a great many improvements were decided upon, and the switchboards of all of our offices transformed from the old magneto system to the now standard common battery plan, and to show how rapidly improvements follow one upon another I may say that before we had installed Cortlandt Street on the common battery system the Harlem office, in which it was first installed only three years ago, had outgrown its equipment, and a new building had been started for a greatly enlarged central office with improvements not known at the time the Harlem office of three years ago was installed.

At the time of its installation the first Cortlandt Street switchboard represented all that was best in the telephonic art. The switchboard was large enough to accommodate 5000 subscribers' lines and 600 trunk lines. It was inspected and studied by engineers from at home and abroad, and was regarded as so great an improvement over what had gone before that this society met to visit and inspect it in a body. But to-day there are those young in the business who laugh at our boasted improvements of 10 years ago, and we, who were responsible for its installation, find it hard to justify to-day those plans about which we then boasted so much.

It is my hope and wish that we shall all live to again visit the Cortlandt Street exchange at a time when the apparatus to be inspected to-night will be as antiquated as that which was the occasion of our first meeting in this building.

I shall say a word or two about some of the significant changes which have taken place during the last 10 years in this building.

Ten years ago, to operate each subscriber's transmitter, it was necessary that two cells of Fuller battery be provided at each telephone station. To-day, in the new switchboard, we are operating on the common battery plan, no battery being required at the subscribers' station, all of the battery being concentrated at the central office and taking the form of large storage cells.

Ten years ago, in order to signal the central office, each station was provided with a small alternating-current generator operated by hand. To-day the generator is dispensed with at the subscribers' station, and the signaling is automatically performed when the subscriber takes the telephone from the hook.

Ten years ago, when the subscriber had finished talking, it was not only necessary that he should hang the telephone on the hook, but it was also necessary that he should give a brisk turn to the crank in order to send a clearing-out signal to the central office. To-day this is unnecessary; the act of the subscriber in hanging his telephone on

the hook automatically lights a signal in the keyboard which notifies the operator to clear out.

Ten years ago, notwithstanding our numerous instructions in the telephone book and requests to subscribers that they should notify the operator to clear out by turning the generator crank when through talking, it was necessary for the operator, owing to the failure of the subscriber to remember these instructions, to listen-in to see whether the subscribers had finished talking, and it was not only necessary to listen-in, but it was necessary for the operator to ask, "Are you through?" Unfortunately, owing to the strenuous conditions under which the then operator worked, she almost invariably reversed the order in which she conducted these operations, too often breaking in on the subscriber in the midst of his conversation, asking, "Are you through?" and then listening afterwards.

It will not be necessary to enter into details on this point in order to bring vividly to your mind the conditions which I have attempted to describe. At the present time, when two subscribers have finished talking, two lamps are lighted in the connecting cords in front of the operator in control of the connection. The lighting of these lamps means that both subscribers have hung their telephones on the hooks and have relinquished control of the line. Seeing the lamps lighted, the operator is not obliged to connect herself into the line, and is not obliged to ask whether the subscribers are through, but knows of necessity that both subscribers have hung up, and that the only thing for her to do is to disconnect both lines.

It is owing to this fact that one of the greatest advantages of the common battery system is realized. A substantial improvement in the service arises from relieving the operator of the duty of supervising the connections by listening in. She can now supervise visually by glancing at the condition of the lamps to see whether they are lighted or not. The operator, thus relieved of the old-time supervision, can handle a much larger number of lines than formerly. Consequently, fewer operators are required and, furthermore, what is also important, fewer sections of switchboard are required. In the system of 10 years ago, there were 44 sections of switchboard installed upon the eighth story of this building. A new story has been added, but the floor space is identical in amount with that contained in the old story. At the present time 9000 lines are placed in a room of the same area which formerly contained the 5000-line switchboard, and the number of operators employed is not much greater than before. These constitute two of the important advantages of the common battery switchboard: The simplifying of the labor of the central office and the vast improvement in the character of the service rendered to the subscriber.

In addition to these, another improvement, by no means to be neglected, has been obtained. While formerly it was necessary to maintain two cells of Fuller battery at each subscribers' station, at the present time no battery at the subscribers' station is required, all of the current being provided from a few cells, although very much larger cells, at the central office. This relieves the subscriber from the annoyance formerly occasioned by the visits of the telephone battery men to make periodical renewals of the Fuller cells, which in the case of busy subscribers took place sometimes as often as once in two months.

The idea of a common battery switchboard was not new 10 years ago. Many attempts to attain such an end were made, the principal idea being, however, to avoid the necessity of renewing batteries at subscribers' stations, no thought being given to the advantages accruing in the way of operating at the central office. When finally the result was obtained it was found to the surprise of many that, while the doing away with the battery renewal at the subscribers' station was accomplished, and while this was by no means an unimportant factor, nevertheless, when considered with reference to the improvement in the quality of the service rendered, it was found to be of subordinate value.

When to-night you view this modern installation you will no doubt, having in mind the Cortlandt Street of 10 years ago, be impressed with the fact that a vast amount of complication has been added to the system, and I think you will find it difficult to resist the idea that the tendency to complexity, which will be perceived, is, to some extent, unfortunate. But to this I can only say that the requirements of the modern telephone exchange have become more and more exacting, and that a telephone exchange located, as Cortlandt Street is, in the financial and business center of this country, has to be constructed with reference to the various complexities which there arise. There have to be considered those waves of excitement, those rushes of business, those financial panics, those concentrations of calls resulting from national celebrations, from explosions, accidents, etc., which unfortunately are so increasingly frequent in our modern civilization. To all of these influences the telephone exchange in general, and the New York telephone exchange in particular, is peculiarly subjected, and it is at these very times that the telephone is at its best. We should be derelict in our duty, therefore, if we did not plan our vast and complicated system so as to stand these sudden demands which no human foresight can avoid.

Even a harmless practical joke started on its way by some wag would, unless we provided sufficient reserve power, seriously embarrass the working of our system. Not long ago, a joke akin to the Tom Collins joke of old was started in New York. A practical joker would tell his friend to call up Mr. Fish at — Broad on a matter of importance. The friend so informed would call up the number, only to be asked which Mr. Fish he wanted to talk to, because that number was at the Aquarium. For about a week this joke raged, and it took the services of a number of special operators to intercept calls for the Aquarium and flash the joke in the pan, as it were, at the central office. Afterwards some minor jokers started a similar lot of calls for the menagerie at Central Park and for the zoo in the Bronx, sending their victims to the telephone to call up Mr. Wolf, Mr. Fox, etc.

Thousands of calls a day are received from subscribers who wish to know who is the nearest subscriber to a given number on a street named. It would be more troublesome to refuse these calls than to attend to them, so that provision for handling such contingencies must be made. In New York, the Saturday half-holiday has resulted in crowding into a very small space of time an enormous amount of business on Saturdays, and when Saturday half-holiday precedes a legal holiday the rush of business is intense.

In consequence of these conditions, our plans must be made on such a liberal scale that we can handle the business at the busiest periods even when they occur at infrequent intervals. To meet these contingencies we have, in addition to installing a large amount of additional apparatus, provided a large number of special operators called monitors, whose sole duty it is to relieve the subscribers' operators of the necessity of holding conversations with the subscribers and to take the request of the subscriber, whatever it may be, and see that adequate and polite attention is given to it. All of these conditions have been taken into account in making the plans for the installation which you will inspect to-night, and to some extent account for the complexities you will observe which were not present in the Cortlandt Street of 10 years ago.

But in making the comparison between the old system and the new, I wish to call your attention to other conditions which, when rightly viewed, will establish the fact that after all there has been a successful movement in the direction of simplicity. It should be borne in mind that in the old system there were required at each subscribers' station two cells of Fuller battery, which would in an installation of the present magnitude amount to 18,000 cells. All of these Fuller cells have been displaced by 11 cells of storage battery of the chloride type located at the central office and occupying only 110 sq. ft. If the 18,000 cells of Fuller battery were assembled at the central office and arranged on racks in the most economical way, it would occupy a very large space. In the old system a small alternating-current generator was required at each station. If these generators and batteries were massed at the central office, they would together occupy a space almost equal to that occupied by the entire common battery switchboard itself. The total weight of the present storage cells is only about 11,000 lbs., and that of the local batteries would amount to over 216,000 lbs.

During the last 10 years many improvements have been made in underground telephone cables, but the main ideas of their original construction have been adhered to. Dry cables have taken the place of filled cables, paper has entirely displaced cotton, and the improvement has been in the direction of placing a larger number of pairs of wires in a given lead sheath. Cables of 200 pairs are now the rule where formerly only 50 pairs were used.

A vast amount of detail in construction and engineering has been worked out, and Mr. J. C. Rennard, our assistant chief engineer, who has carried on the practical engineering work of the New York installations, will describe to us many features of interest.

The installation in all of its parts has been constructed by the Western Electric Company, which was the concern which installed the old Cortland Street board, and which as much as any other single

agency has contributed to the forward condition which the art of telephony has attained not only in this country but abroad.

Nearly all branches of electrical engineering have been drawn upon in making this telephone installation, and to deal exhaustively with even one of the important details of the work would take up the entire time of the meeting.

Mr. Carty was followed by Mr. J. C. Rennard, assistant chief engineer, who, with the aid of large diagrams, explained the common battery exchange circuits. After outlining in a general way the various features of interest which were to be shortly viewed by the members, Mr. Rennard gave an outline sketch which was of the greatest interest to the large number of engineers present. Among other things, he stated that the Cortlandt Street installation required for its operation 13,875 miniature incandescent lamps which, so far as numbers are concerned, would represent a fair-sized central station. When considered from the standpoint of energy consumed, of course, the comparison did not hold good, the total amount of capacity available and needed for the operation of the central office for all purposes being 75 kw. In the switchboard itself over 469,000 spring jacks are installed, being connected together and to the other parts of the apparatus by over 400,000 ft. of cable containing more than 25,000,000 ft. of wire. The switchboard itself has a capacity for 9600 subscribers' lines and more than 15,000 stations.

After Mr. Rennard's interesting remarks were concluded, the members of the society were taken through the central office in groups, guided by details from the chief engineer's staff. So interested were the members in viewing the installation that they remained until a late hour, and it was the opinion of all that they had spent an enjoyable and profitable evening. The exchange was illustrated in ELECTRICAL WORLD AND ENGINEER, Nov. 9 and Dec. 7, 1901.

Static Strains on High-Tension Circuits and the Protection of Apparatus.

MR. PERCY H. THOMAS, at a special meeting of the American Institute of Electrical Engineers on Feb. 14, read a paper with the above title, discussing the so-called static effects in high-tension circuits, especial attention being given to the disturbances produced by lightning, switching, grounding and the like. As the paper is quite voluminous—covering 44 pages of the Institute *Transactions*—but a brief resume can be given in the space here available. The paper is divided into two parts, one of which is on the nature, causes and effects of static disturbances; and the other on the protection of apparatus and on a new type of appliance called "static interrupter."

The author coins the word "undic" to designate those changes of potential and waves of current of an abrupt nature, which result from the transfer of electrostatic discharges of a system from point to point. The elementary principles underlying the phenomena considered are presented, and with particular reference to their occurrence in transmission lines and connected apparatus. The case of a long-transmission line is considered at some length, accompanying curves illustrating the charging waves of such a line, and the case of cables is similarly treated. Following is a summary of the conclusions reached in the first part of the paper:

1. When a "dead" transformer is connected to a live line a strain may be produced on the layers of the coil next to the terminal which may be as great as the line voltage.

2. When a short line is charged suddenly from live bus-bars, a momentary voltage rise may be produced which will be not more than double voltage.

3. When a long line is charged a strain similar to that in the short line is produced, doubling the potential first at the end of the line and afterward along the whole length. This result assumes that the terminal of the line is abruptly raised to full normal potential and rigidly maintained there until the wave is fully formed; also that the losses are zero.

4. The fundamental principles governing the charging of a cable are the same as those of a transmission line.

5. Opening a light high-tension circuit is nearly the equivalent of charging the circuit, since before the line is completely freed from the bus-bars it is often momentarily recharged several times.

6. When a branch line of small e. s. capacity is supplied from a main line, the rise of potential at the farther end may be twice as great as at the end of the main line.

7. In addition to switching, other causes of static strains are grounding, short circuit, lightning, etc., when these cause abrupt changes of potential.

8. A rise of potential due to resonance is always possible, but generally improbable. It requires that there be an oscillating circuit and an exciting cause which must be of very nearly the same frequency as the oscillating circuit. When an alternating e. m. f. of high frequency is applied to a long line the danger that resonance will occur is usually greater.

The second part of the paper—on the protection of apparatus and on the "static interrupter"—is developed under the following heads: Tracing of damage caused by static, protection from static, protection against short circuits, static interrupter, protective power of static interrupter, location in circuit of static interrupters, features of the commercial static interrupters, protection against grounds, lightning arresters, series resistance, location of arresters.

The static interrupter, to which a great part of this section of the

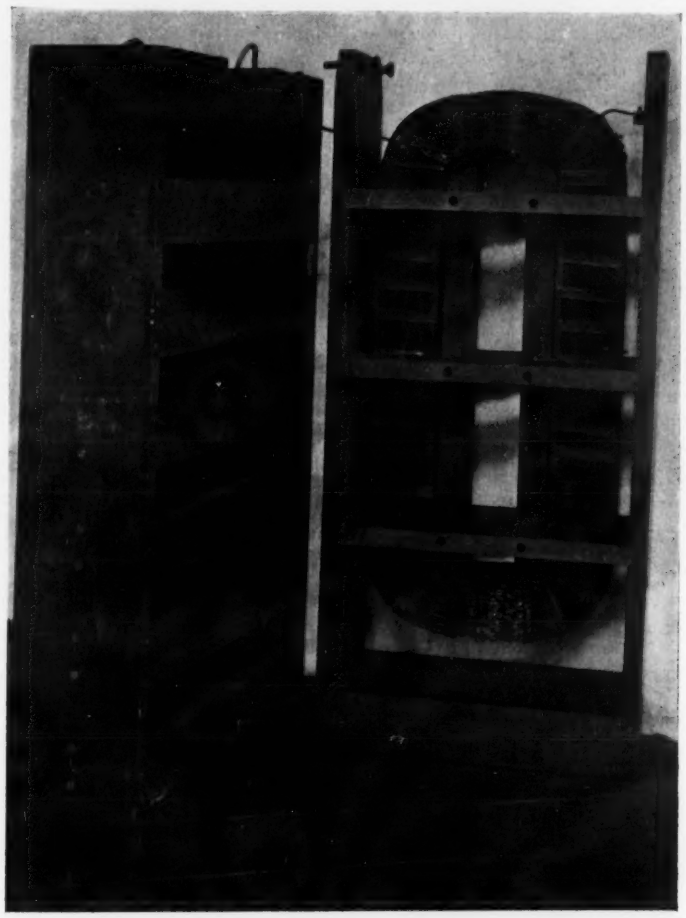


FIG. I.—STATIC INTERRUPTER OPEN.

paper is devoted, is shown in the accompanying illustration. The apparatus is a combination of a choke coil and a condenser connected in such a way as to magnify the effect of the choke coil as regards static waves, without causing a sensible derangement of the normal operation of the circuit. It is stated that by the use of this device a comparatively small coil can be made to afford the same protection as a coil of much larger dimensions, without entailing either excessive cost or excessive loss of energy, or heating. The choke coil of the interrupter is connected in series with the line, and the condenser is connected by one terminal between the choke coil and the winding to be protected, and by the other terminal to such parts of the apparatus as have electrostatic capacity with respect to this high-tension winding. In the case of a transformer this would be the low-tension winding in the core. As the parts designated are always at ground potential, the second condenser terminal may be connected directly to ground.

As to the location in circuit of such interrupters, one may be placed in each lead wire of a transformer or other apparatus connected with the source of static disturbance, such as a line or a high-tension switch. As switching is a frequent cause of static strains, the interrupter should in general be placed between the apparatus and the

switches, thus making the interrupter virtually a part of the generator or transformer to be protected, and not a part of the line. In case of a bank of transformers, if there is no switching of individual transformers, it will be satisfactory to arrange the apparatus so that several transformers are protected by the same interrupters. For example, in polyphase systems a group may be protected as a unit, instead of giving individual protection to each transformer.

As to the construction of interrupters, they are usually single pole, one coil and one condenser being placed in the containing case surrounded by oil. The actual capacity of condensers for static interrupters is much larger than the electrostatic capacity of the windings they are to protect, but is still very small—some not exceeding a few hundredths of a microfarad. Fig. 4 represents diagrammatically a static

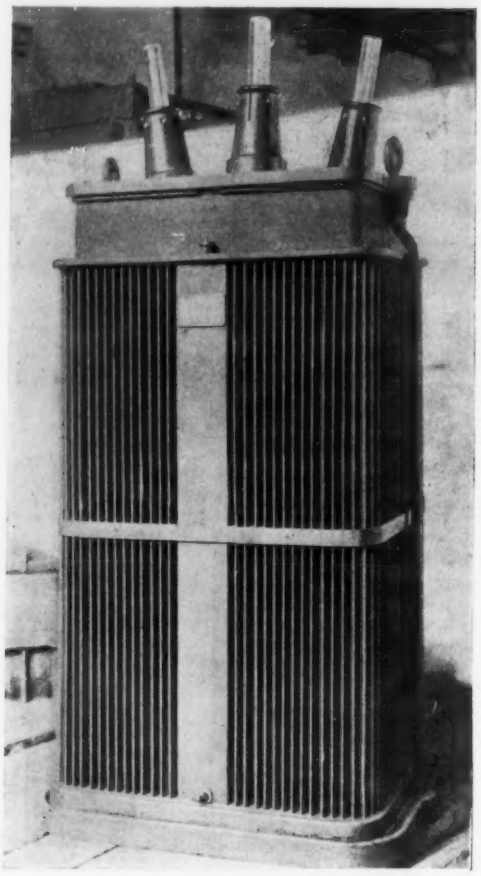


FIG. 2.—STATIC INTERRUPTER, WITH CASE COMPLETE.

interrupter protecting a transformer and a high-tension generator. Following is a summary of the second portion of the paper:

1. Damage resulting from static strains is of two sorts: short circuits and grounds. It is the function of the static interrupter to protect apparatus against such short circuit strains; it is the function of the lightning arrester to discharge the line of excessive static charge and thus prevent grounds.

2. The static interrupter consists of a choke coil and condenser, the latter being connected between line and ground on the apparatus side of the choke coil. The interrupter delays and smoothes out static waves which attempt to pass it. The condenser by absorbing a large part of the static charge which passes the choke coil very much increases the effectiveness of the coil.

3. The choke coil and condenser of the interrupter must be adapted to the circuit upon which it is to be run, and must be proportioned with regard to the design of the apparatus it is to protect. The interrupter should, as a rule, be placed nearer the apparatus than any switches which are to be operated with potential on the line. The interrupter is thus essentially a part of the apparatus to be protected and not a part of the line or the arrester.

4. Lightning arresters must be able to discharge electricity from the line as fast as it actually appears there, and must also be non-arcing under all conditions. Any resistance or inductance used in series with the arrester should be low enough to allow the passage of all actual discharges without causing excessive potential on the arrester.

5. On the systems where the apparatus is distributed the arresters should also be distributed.

On systems with apparatus concentrated at a few points arresters should be placed on each line wire where it leaves a station.

6. Well designed static interrupters and lightning arresters, properly arranged, furnish a complete system of protection against the static disturbances found on high-tension lines.

The author concludes that it is quite evident that the protection of the apparatus of a large high-tension system, with its numerous

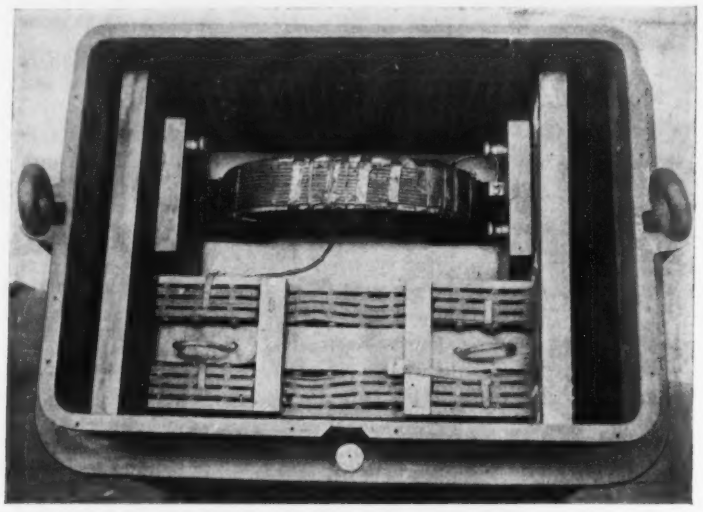


FIG. 3.—VIEW OF STATIC INTERRUPTER FROM TOP.

opportunities for static disturbances and its widely spread apparatus, is by no means a simple problem, to be solved off-hand by the use of a few lightning arresters of any available style. The type and location of the protective devices must be adapted to the actual conditions of the plant; the severity of the lightning in the neighborhood, the voltage of the system, the type of apparatus to be protected and perhaps the actual constants of the circuits. The determination of the most

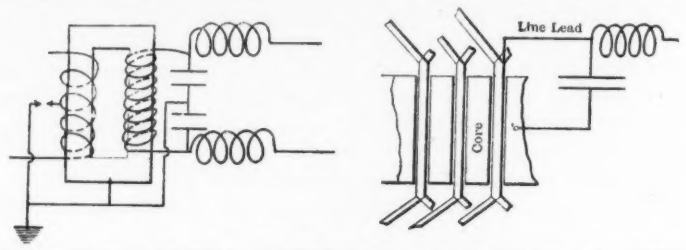


FIG. 4.—STATIC INTERRUPTER PROTECTING A TRANSFORMER AND HIGH TENSION GENERATOR.

satisfactory protection is a matter to be arrived at from a combination of theory, experience and experiment, and any protective system should be modified when actual trial shows a better arrangement.

Monorail Road in Scotland.

Plans have been submitted to the Government Board of Trade, according to a recent dispatch from London, for the construction of a monorail system between Edinburgh and Glasgow. The distance between the two cities is 49 miles.

Pacific Cable Report.

Congressman Corliss has prepared the majority report of the House Committee in regard to his bill providing for government ownership of the Pacific cable. The report rehearses the evidence, and the familiar facts already noted. The vote authorizing a favorable report on the bill stood 8 for and 7 against. Two members, Mann (Rep., Ill.) and Davis (Dem., Fla.), who are favorable to the bill, were absent, and since the meeting two of the members, Lovering (Rep., Mass.) and Wagner (Rep., Penn.), who voted against the bill in the committee, have signed the favorable report, suggesting an amendment authorizing the purchase of the cable contracted for between California and Hawaii. The minority of the committee opposes Government ownership and favors the proposal of the Commercial Cable Company to lay a private cable.

Opening the New Carnegie Laboratory at Stevens.

As most of our readers no doubt know from the daily papers there was held at the Carnegie Laboratory of Engineering, recently erected on the grounds of the Stevens Institute of Technology in Hoboken, a series of dedicatory ceremonies, etc., of a character involving many items of interest to the mechanical engineer. The occasion was in form the mid-winter meeting of the Alumni Association of the Stevens Institute, but the special business consisted in the presentation of the Carnegie Laboratory of Engineering by Mr. Carnegie to the trustees of the Institute, and the presentation to Mr. Carnegie by President Morton on behalf of the Alumni of a solid silver box containing a piece of the first T-rail ever made, which was the design of Mr. R. L. Stevens, and made under his personal supervision in 1830. These ceremonies were followed by a collation involving many novel features.

The meeting having been called to order about 8.30 P. M., and a little formal business disposed of, a temporary adjournment or intermission was taken, awaiting the arrival of Mr. and Mrs. Carnegie, who, with some members of the Stevens family, had been dining with President Morton at his home near by. As soon as this delegation arrived, at the request of Mr. C. H. Page, the chairman of the meeting, Mr. William S. Ackerman, of Ackerman and Ross, the architects of the building, presented the keys of the same to Mr. Carnegie, who then made one of the most brilliant speeches of his life, at the conclusion of which he presented the keys (as typifying the building) to Mr. S. Bayard Dod, the president of the board of trustees.

OPENING OF CARNEGIE LABORATORY.

In the course of his speech, which was sparkling with wit and good humor throughout, Mr. Carnegie proposed as an appropriate epitaph for himself, "Here lies a man who knew how to get around him men cleverer than himself." This speech was followed by the presentation of the rail in its silver receptacle, an admirable piece of artistic work, doing great credit to the Tiffanys, who made it, and to the artist, Mr. A. D. Turner, who designed it.

In his speech on the reception of this box, which had on one end a medallion likeness of himself and on the other one of Robert L. Stevens, Mr. Carnegie passed from humor to serious words of appreciation of the honor done him by thus uniting him with Mr. Stevens, who had been described by Abram S. Hewitt as "the greatest mechanical engineer, the greatest naval engineer, the greatest railroad engineer which the nineteenth century has produced."

In the course of his first speech Mr. Carnegie made some appreciative references to President Morton in response to whose request he had agreed to erect the Carnegie Laboratory building, and in explaining to the Alumni the commercial value of a good name, said humorously: "Call it Morton, and you can get anything for it you choose to ask." To this sentiment Mr. Carnegie gave a further concrete meaning the next day when he directed his banker, Mr. Franko, to send a check for $100,000 to President Morton for the endowment of the same building.

After the ceremonies, the meeting adjourned to the second floor, where was in readiness a collation such as has never been seen before. The accompanying photographic picture shows one of the many tables. On the center of this one was set a completely equipped model of a modern blast furnace, which, however, delivered not melted iron, but punch when "tapped" in the usual manner into "ladles" mounted on trucks running on tracks laid along the table. One of these "ladles" is shown in the picture in the act of being filled. On another table was an "open-hearth" furnace so illuminated as to look red-hot inside, but yielding fried oysters when explored with a long spoon. On another table was a Bessemer converter which from time to time ejected flames and showers of sparks, but also yielded on demand fancy cakes. At various points were set kegs filled with railroad spikes of the regular size and shape (these were invented by Mr. Stevens), but made of bread and cake. The ice cream was served in the form of T-rails and steel ingots, and numerous ingot moulds on trucks were filled with chicken and lobster salads, etc.

Mr. Carnegie was much interested in many of these novelties; made the Bessemer converter eject flames and sparks, remarking, "This is the first time I have operated a Bessemer converter myself." He also personally attended to the distribution of punch to the ladies, and gave many toasts.

A good deal of this ingenious work or play depended upon electricity. The decorations shown in our picture were done by the National Improvement Company, with its "Elblight" system, which it will be remembered was installed with such surprising expedition and success at the Institute annual dinner. At Stevens the company installed 1000 decorative lamps, complete, between 8 A. M. and 6 P. M., the same day, using white and red lamps spiked into green cable spiralled with smilax. The effect was admirable. Current was available from the Allis-Corliss-Edison bipolar direct-current unit, and from the regular city circuit two-phase supply.

This spring the Institute will see the beginning of the new chemical laboratory, named on account of its donors, the Morton-Alumni Building. Stevens has plenty of use for these new accommodations, there being now about 300 students, or more than ever before, while the entries are rapidly growing in number. The success of Stevens men in engineering work is familiar to all our readers, and it is believed by the trustees that the new facilities will keep the old Institute fully abreast of the times. We are indebted to Professor Albert F. Ganz, of the Institute, for the photograph and above data.

Meeting of the Institute at Columbia University.

At the extra meeting held in Havemeyer Hall, Columbia University, Friday evening, Feb. 14, Mr. Percy H. Thomas, of the Westinghouse Electric & Manufacturing Company, lectured on "Static Strains in High-Tension Circuits and the Protection of Apparatus." About 400 members and guests were present, with President Steinmetz in the chair. Mr. Thomas made many experiments, showing the concentration of potential in the outer portions of transformer or generator windings resulting from the operations of switching, grounding, short-circuits, lightning, etc. Also the protection of windings by choke coils and the "static interrupter." A mechanical model of a transmission line showing the formation of waves in the charging of a line was also exhibited.

This model received high and well merited praise for its ingenuity in clearly showing the wave forms due to the varying conditions in the operation of a transmission line. But little time remained for discussion, in which Messrs. Steinmetz, Scott, Fisher, Blackwell and Torchio participated. A hearty vote of thanks to the speaker of the evening preceded the motion for adjournment. The paper is abstracted elsewhere in this issue.

Chairman Rice, of the committee on papers, and Chairman Mullin, of the committee on transportation and accomodation, after a visit to Great Barrington, Mass., recommended, and it has been decided, that the date of the annual convention to be held in that town be changed to June 17, 18, 19, 20, a special train to leave New York on June 16. This was deemed necessary in order to assure ample accommodation, as it is believed that the preparations being made will lead to a much larger attendance than was originally anticipated. All the available space in the "Berkshire Inn" and all the rooms in the "Barrington" will be reserved for the occasion. The famous Berkshire Hills are in their early summer glory in June, and a better season for visiting them could not be selected.

Dr. Sheldon on the Storage Battery.

A very interesting experimental lecture was given on the storage battery by Dr. S. Sheldon on Feb. 11, before the Automobile Club of America. In the course of his remarks, Dr. Sheldon called attention to an interesting phenomenon he had noticed, and of which he had not been able to find previous mention. If an alternating current be sent through a dilute solution of sulphuric acid, by means of lead electrodes, there will be formed lead sulphate at both electrodes, pro-

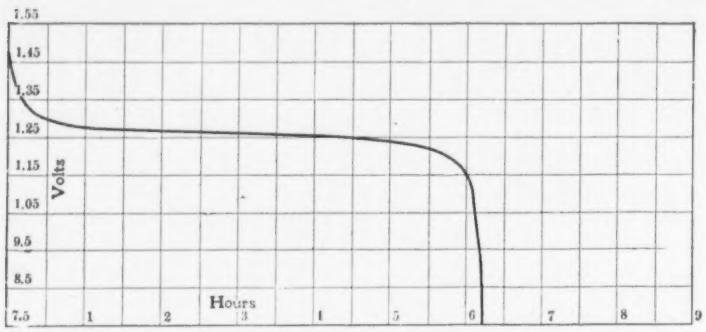


FIG. 1.—CURVE OF EDISON AUTOMOBILE BATTERY.

viding the current density and the frequency be properly adjusted, and the electrodes will be attacked and dissolved. If the frequency be lowered, a limit will be reached, and if it be exceeded the formation of lead sulphate will cease and each electrode will become alternately peroxidized and reduced.

If a direct current be sent through concentrated sulphuric acid by means of lead electrodes, both electrodes will be attacked and lead sulphate will be formed. Hydrogen in a gaseous form is developed at the cathode in addition to the lead sulphate and a gas, and what appears to be free sulphate is developed additionally at the anode.

These phenomena are probably in some way related to the variation in solubility of lead sulphate with the concentration and temperature

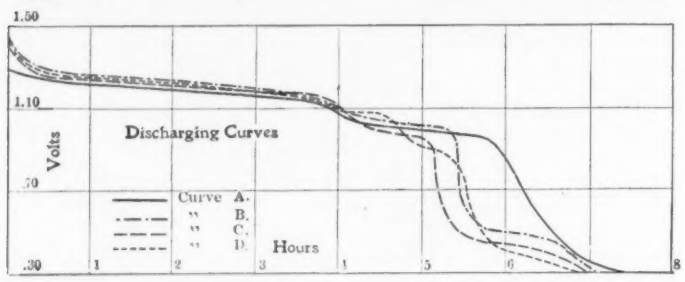


FIG. 2.—CURVES OF ENDURANCE TEST OF EDISON STERAGE BATTERY.

of the electrolyte. Differences in the rapidity of the chemical reactions are also involved.

Dr. Sheldon gave a description of the Edison storage battery, and illustrated his remarks by two sheets of curves, which, he said, had been received from Mr. Edison earlier in the day. Both sheets of curves are reproduced herewith. In Fig. 1 are plotted the data of the first test of a full-size automobile 18-plate cell, entirely machine made. The curves of Fig. 2 were plotted from the data of an endurance test. The full line curve corresponds to the first discharge of a cell, and the other curves, *B, C, D,* to, respectively, the 137th, 157th and 313th discharges of the same cell. This cell had up to the date of the lecture been discharged and charged more than 500 times, and without beginning to show any indications of fatigue. Moreover, since it was desired to make the test a drastic one, that rate of discharge has been twice the normal rate.

Electrical Literature for Chinamen.

It is stated that Gong Hee, a Chinaman, who is a practical electrician, graduated from the Portland (Ore.) Technical School, is writing a book on electricity in the Chinese language. The book, which will be a complete treatise in simple electricity and electrical application, is an extended translation of American text-books, with exhaustive original explanatory addenda, made necessary by the difficulty in translating electrical terms into a language which knows nothing of them.

New Telephone Patents.

Telephony contributes but two patents to the issue of Feb. 11, and neither scores any striking advance in the art. One is an addition to the noble army of receivers, and merely goes to show that all the possible shapes in which receiver magnets may be assembled have not yet been exhaustd. The other emanates from Sweden, and re-

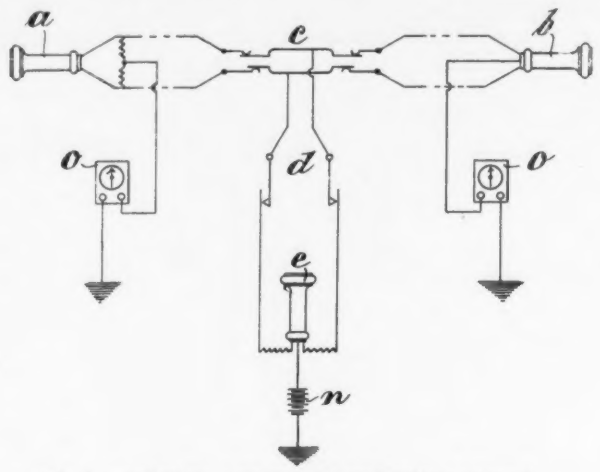


FIG. 1.—STAFSING AND EGNERS TELEPHONE SYSTEM.

lates to a detector device for the purpose of showing the subscriber if the operator is listening in or not—a device which stands little chance of adoption in such a practical telephone land as Sweden, and less in this country.

The latter device is the invention of Messrs. Frans Stafsing, of Stockholm, and Carl Egner, of Klippan, who have drawn up a specification of such delightful quaintness that it would be a pity to con-

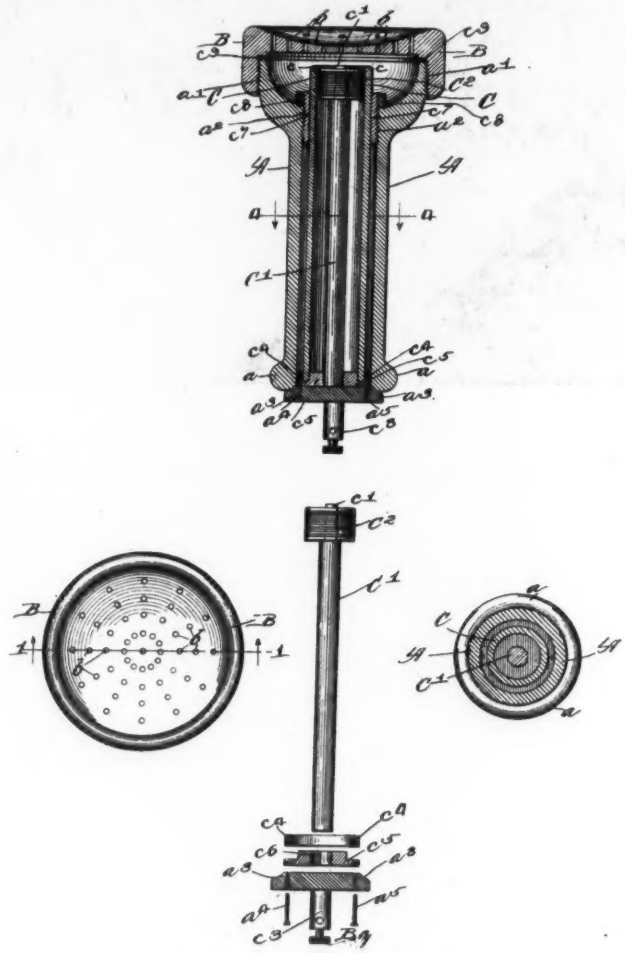


FIG. 2.—NOLEN'S TELEPHONE RECEIVER.

sign it all to oblivion. For example, they say: "It is well known that the operators of a telephone exchange are often obliged to connect their receiving apparatus to the subscribers' circuits in order to ascertain whether a discourse has begun or has been finished. This listening, however, is not seldom, to the detriment of the clearness

of the sound transmitted, and to the displeasure of the subscribers, prolonged for too long a time.

"The object of the present invention is improvements in telephone systems by means of which the persons using the telephones are enabled to observe whether any undue listening takes place or not. By this means the great advantage is also gained that the operators may be spared being unjustly accused of listening.

"The invention consists, briefly, in connecting to the circuit of the operator's receiver of a usual telephone system an extra source of electric current, in such a manner that extra electric currents are sent out in the subscribers' circuits as soon and as long as the receiving apparatus of the operator at the exchange is coupled to the said circuits, and in connecting to the subscribers' circuit some suitable signaling apparatus which will give visible or audible signs when the listening is taking place."

The diagram shows clearly the nature and simplicity of the invention. Connected to the neutral point of the operator's set is a grounded battery *n* and connected similarly at each sub-station is a grounded detector *O*. "As soon and as long as" the operator depresses listening key *d* current flows through the detectors and the subscriber is thereby notified that the operator is listening in.

Mr. James G. Nolen, of Chicago, patents a telephone receiver, in which the principal novelties are an arrangement of magnets consisting of a cylindrical magnet surrounding the usual bar magnet and coil, and an ear-piece having a number of small perforations instead of a single large one. This novelty in design causes it to become "a matter of indifference as to the exact position of the telephone cap with reference to the ear of the operator, as it is hardly possible to hold the cap of the receiver to the ear without the interior of the ear covering one or more perforations in the said cap." That the "interior of the ear" covered anything except its own contents is something new in anatomy, and it would also be news to know that telephone users in general have hitherto had much difficulty in covering with their ears—even though they do use the exterior ear for the purpose—the standard telephone ear piece with its single perforation. The patent also covers an arrangement of parts whereby all the electrical portion of the instrument may be removed from the case without disturbing the connections. The drawings show clearly the construction of the instrument, including the perforated ear piece. The cylindrical magnet *C*, having a rounded polar end *c*, surrounds the coil C^2 and bar magnet C^1 to which it is connected magnetically by the washer c^5 and ring c^4, which is firmly fixed to C^1, c^5 being made fast to c^4 and ring a^4 a^5 passing through the cap a^3 and washer c^5. The cylindrical magnet *C* is made fast to the case by a tightly fitting thimble C^7, threaded to screw into the case, and held by a check-nut c^8 when in place.

CURRENT NEWS AND NOTES.

INSURING MR. MARCONI'S LIFE.—A dispatch from London states that the directors of the Marconi Wireless Telegraph Company have insured the life of Mr. Marconi for $750,000.

PROFESSOR ROWLAND CREMATED.—It may not be generally known that the remains of Professor H. A. Rowland were cremated and that the ashes have been deposited in a niche in the walls of his laboratory at Johns Hopkins University.

WIRELESS TELEGRAPHY FOR THE PRINCE.—It is stated that the "Kronprinz Wilhelm," of the North German Lloyd line, bringing Prince Henry of Germany, will have on board a Marconi ship wireless telegraph set of the latest kind, and that she will probably signal with it anywhere for 200 up to 1000 miles. This set can "duplex" or talk at once with two shore instruments differently tuned.

DOUSING LIBERTY'S GLIM.—The notice of the Lighthouse Board, published last week, that the light in the torch of the Statue of Liberty in New York Harbor would be discontinued on or about March 1, was taken by many to mean that after the date named there would be no lights held aloft in Liberty's hand. The notice meant, however, that the statue will cease to be an official lighthouse in New York Harbor, but the War Department will henceforth provide for the lighting of the torch. Assistant Adjutant General M. V. Sheridan, stationed on Governor's Island, states that the President had transferred that part of Bedlow's Island back to the War Department, where it belonged several years ago.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The committee charged with the arrangements for the inaugural meeting of the American Electro-Chemical Society announces that it is the present intention to hold a meeting at Philadelphia, Pa., beginning on the evening of April 3, which will be devoted to organizing the society, and continuing during the days of April 4 and 5, which will be devoted to the reading and discussion of papers, experimental demonstrations, visits to installations, social functions, etc. The preliminary programme will be issued as soon after March 1 as practicable. Up to the present, 294 names are on the rolls of the society.

MEETING OF A. I. E. E.—The 162d meeting of the Institute will be held at the house of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Friday evening, Feb. 28, at 8.15 o'clock. The general subject of the meeting will be "Electro-Chemistry and Electro-Metallurgy." The following papers will be presented: 1. "The Electro-Chemical Industries," by Dr. Samuel Sheldon, of Brooklyn; 2. "The Electric Furnace in Industrial Chemistry," by Charles B. Jacobs," of New York; 3. "Electrolytic Recovery of Copper from Low Grade Ores," by Dr. Nathaniel S. Keith, of New York; 4. "Colloids," by W. R. Whitney, of Boston; 5. "Liquid Potentiometer; Determining Electrolytic Resistance with Direct Current Instruments"; 6. "Point of Cut-off in a Battery Discharge"; 7. "Electrolytic Conduction without Electrodes," by Dr. Carl Hering, of Philadelphia.

NEW TYPE OF DRY CELL.—A new type of dry cell forms the subject of a patent issued Feb. 11 to W. McA. Johnson. The receptacle of the cell is of glass or porcelain, and the exciter is a double salt of zinc, the electrodes being zinc and oxidized copper gauze, respectively, surrounded by an absorbent material such as sawdust. The inventor states that heretofore it has been common to use in batteries having electrodes of zinc and copper oxide an alkaline solution such as potassium hydrate. When, however, such a cell works on a closed circuit, the zinc goes into solution, displacing the hydrogen of the hydrate and forming potassium zincate. The hydrogen thus displaced reduces the copper oxide, and such action causes the depletion of the alkali. By the use of potassium cyanide, or an equivalent substance, which is capable of increasing the ability of the solution to dissolve zinc without increasing its corrosive action, this depletion of the alkali can be largely prevented. This desirable result is due to the fact that potassium cyanide forms with zinc a soluble double salt, thus freeing the solution of zincate and thereby preventing the clogging of the cell.

PRODUCTION OF FLUORINE.—M. Maurice Meslans, of Paris, has patented under date of Feb. 11 a compact and ingenious cell for the commercial production of fluorine, according to the method developed many years ago by Moissan. The method itself involves merely the electrolysis of fluoride of potassium dissolved in hydrofluoric acid, but the chemical activities of the element and the acid are such that the choice of materials for the electrodes, the joints and insulating parts, and particularly for the cell, becomes of vital importance. Moissan has already pointed out the availability of copper for the latter purpose, the metal becoming quickly coated with an insoluble layer of fluoride, which acts as an efficient protector. The Meslans device is constructed somewhat on the lines of the apparatus used by Garuti and Pompili for the electrolytic production of hydrogen and oxygen, and comprises anodes and cathodes of platinum separated by an apertured diaphragm of sheet copper, which, for its more complete protection from the electrolyte, is electrically connected with the anode. Under these conditions the diaphragm is soon covered by the protecting fluoride layer, which arrests further action. Both anode and cathode are water-cooled, and the evolved hydrogen and fluorine are conducted through refrigerated coils to condense and return any hydrofluoric acid. The plan of shunting a portion of the electrolyzing current through a metallic diaphragm to protect it has been heretofore adopted by Darling in an apparatus for the decomposition of fused nitrates. The device of Meslans presents, therefore, little novelty.

NORTH CAROLINA WATER POWERS.—The Division of Hydrography of the United States Geological Survey has issued a bulletin dealing with the measurement of North Carolina water powers.

INTERNATIONAL EXHIBITION OF MOTOR-BOATS.—A circular, signed by the Count A. de Talleyrand-Perigord, informs us, that an exposition and competition of motor-boats and equipments with motor power for sailing boats, will be opened in June, 1902. This undertaking is of great practical interest for the coast and inland navigation of all nations, and it is expected that the participation of the public interested in the matter will be a general one. The exhibition will take place near Berlin on the lake Wannsee, a most lovely and charming place in the Royal Forest named "The Grunewald." The address of the secretary is Berlin, Universitats str. 1.

SUBMARINE CABLE BREAKS.—The Commercial Cable Company had to repair five breaks to various sections of its cables last year, due to fouling by ships' anchors. The companies are always willing to pay a captain to slip his anchor if fouled, and most cases are on the Newfoundland Banks in the shoal water. One case is mentioned, however, where a captain let go 1600 fathoms, and was given $1,200 for his chain and anchor. The companies are glad to encourage this consideration on the part of sea captains, and, so far as they know, there has been no attempt to take fraudulent advantage of it. The men of the sea are more apt to be impetuous and high-handed than dishonest, and while they will not report fictitious losses, there is frequent evidence that they release their fouled anchors by cutting the cable that holds them. There is but one case on record where this offense was brought home and proved. On Dec. 29, 1898, the schooner "William H. Bailey" was fouled off Sandy Hook and the cable cut. The deed was proved, and, after four years of litigation, an award of $2,500 has just been granted the cable company.

MERCURY DIAPHRAGM.—An electrolytic cell for the decomposition of brine recently patented to Ernest A. Le Sueur, of Rumford Falls, Me., returns to the principle of the stationary mercury diaphragm, familiar in the early constructions of Vautin and Kellner, and in the more recent cell of Langguth. Le Sueur's cell comprises an anode bell, closed at the bottom by a horizontal sheet of wire gauze, the meshes of which are filled with mercury. A layer of gravel rests upon this gauze and supports the anodes, of the filamentary platinum type heretofore described by the same inventor. Each anode comprises a number of ribbons or filaments of platinum or a platinum-iridium alloy, resting upon the gravel and radiating from a central vertical glass tube which carries their common conductor. This anode bell is suspended in an iron tank which constitutes the cathode; the mercury diaphragm operates, therefore, as a bipolar electrode, to transfer the sodium from the brine solution in the anode bell to the water in the containing vessel. The very small amount of mercury used rapidly deteriorates under the influence of magnesium separated from the brine, and it is found necessary to continuously flood the amalgamated gauze with fresh mercury, displacing that which has lost its fluidity. The patentable novelty of the construction lies in the provision of these means.

CHLORATES AND PERCHLORATES.—Since the first announcement by Imhoff of the remarkable effect upon the yield of chlorates and perchlorates of the addition to the electrolyte of small amounts of chromic acid in the form of chromate or bichromate, the conditions most favorable to a high yield have been carefully worked out on a laboratory scale by Muller and Brochet. In seeking to apply these results on a commercial basis, Lederlin has encountered certain unlooked-for difficulties. Chief among these are the oxidizing action of the solution on the cathodes, and the gradual falling off in yield which at the beginning was 90 per cent of that indicated by theory, but which decreases to 50 per cent or less after some days continuance. The changes in the solution which correspond to these effects are marked by color variations, the solution turning from a clear red orange to yellow. Lederlin finds the solution of these difficulties in the addition to the electrolyte of a small quantity of very dilute hydrochloric acid, the effect of which seems to be the maintenance of the chromic acid in the form of bichromate, and, curiously enough, the suppression of free chlorine and the reduction of the chlorometric strength of the liquor. Lederlin states that this simple modification secures a sustained yield of about 90 per cent of the theory, or .70 grams of potassium chlorate per ampere-hour. Another effect not hitherto obtained is the production of electrolytes saturated with sodium chlorate, and capable of yielding crystals of this very soluble salt by refrigeration. Lederlin's patent is issued under date of Feb. 11.

LETTER TO THE EDITORS.

Testing Three-Phase Induction Motors.

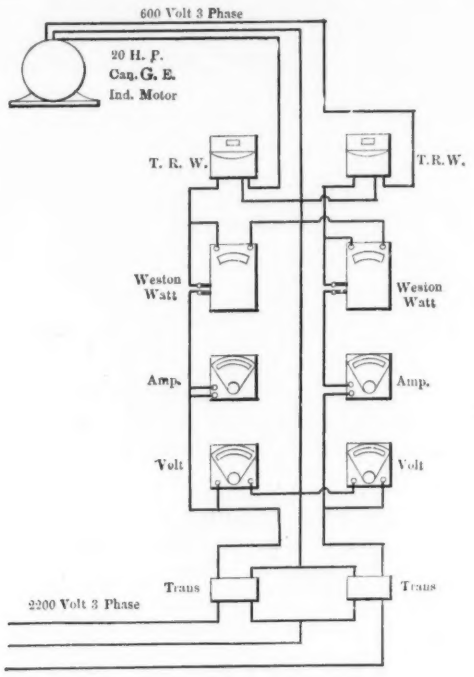
To the Editors of Electrical World and Engineer:

Sirs.—In testing some three-phase induction motors, I have obtained results that seem odd to me, and I ask the courtesy of your columns to get an explanation.

The motor tested was a three-phase 20-hp, 60-cycle C. G. E. induction motor, operating a large blower which runs constantly with no variations of load. The method of testing was as follows: A Weston wattmeter was connected on each leg as shown in the accompanying sketch; that is, the current coil of one wattmeter was put in one leg, and the potential coil was connected from this leg to the middle leg of the circuit. The other wattmeter was connected in a similar manner to the other outside leg.

The watts indicated by the right-hand wattmeter were 8000, and by the left-hand wattmeter, 3600. To determine the power factor of each leg, an ammeter was put in series with the current coil of the wattmeter in each leg, and a voltmeter was put in multiple with the potential circuit of each wattmeter. The readings for the right-hand leg were 15 amperes, and for the left-hand leg 15 amperes. The voltage readings of each leg were 600. This would give the apparent watts of the right-hand leg 9000, and that of the left-hand leg 9000. The power factor of the right-hand leg would thus be 88.8 and that of the left-hand leg 40.

This circuit was metered with two Thomson recording wattmeters



TESTING THREE-PHASE INDUCTION MOTORS.

of the two-wire, single-phase, 500-volt type. One meter was connected on either side of the system, the same as the Weston wattmeters. A check test of these two meters showed the right-hand meter to be correct, and the left-hand meter 11 per cent fast. This left-hand meter was removed and tested on a single-phase circuit with the same load that it had on the three-phase circuit, and showed the same per cent of error, or 11 per cent fast.

As is well known, a recording wattmeter of the single-phase type connected to a circuit with an inductive load will run backwards when the power factor is below 50, but with this meter the load on it showed a power factor of only 40, and still it does not go backwards. To make sure that no error existed in the readings, the instruments were shifted, those on the left-hand leg being placed on the right-

hand, and those on the right-hand on the left-hand, and the results were the same.

What seems odd is that this being a motor circuit, supplying one motor, it is supposed to be balanced. A voltage test of each of the three legs shows that there is no variation—each leg being 600.

I do not see how this can be accounted for, unless one leg is working at a higher inductive load than the other, and in this case it would seem that one set of fields is stronger than the other. If this were the case, I should think that the motor would have an eccentric motion, but this is not true.

I have found the same state of affairs in a number of three-phase induction motors and cannot account for it. The motor is running at about half its rated capacity.

I should be glad to have an explanation offered by some who have had more experience in this class of work than I have had.

MONTREAL, CAN. M. G. STRATTON.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Voltage Drop of Alternators.—ROTHERT.—A reply to the article of Fischer-Hinnen, recently abstracted in the Digest. He claims that Fischer-Hinnen has not applied correctly his (Rothert's) method, in which, he says, the simple diagram cannot be directly used for machines with great stray field and great saturation of the poles. In such cases the excitation required for no-load cannot be simply combined with that for short circuit, but the first must be connected in order to take into account the increased saturation in the field system, due to greater field straying. He shows how this may be done. He claims that his method, if properly and judiciously applied, gives as good results as may be desired. Regarding Potier's method, he says that "any method which does not take into account the variation of the field straying between no load and full load, is wrong, for the modern highly saturated generators, and must be wrong, even if it gives good results for many machines."—*Elek. Zeit.,* Jan. 16.

RESELMAN.—Another communication, referring to Fischer-Hinnen's article, in which he discusses the reason why the method of Behn-Eschenburg gives too low values of the voltage at the terminals at saturation in the poles.—*Elek. Zeit.,* Jan. 16.

Induction Motors Used as Synchronous Motors.—EICHBERG.—A communication referring to the article of Danielson, abstracted recently in the Digest. He tried the same method independently, and believes that it may be used to advantage, especially with large motors, on account of the increase of the power factor and the increase of the efficiency, but only in such cases where no capacity of overloading is required. He discusses the problem with the aid of diagrams.—*Elek. Zeit.,* Jan. 16.

REFERENCES.

Heyland Induction Motor.—HEYLAND.—A translation in full with the illustrations of the German article, which was abstracted at length in the Digest, Jan. 25.—Lond. *Elec.,* Jan. 24.

Induction Motor.—WIENER.—An illustrated article with several tables, in which he discusses in a popular way the principle of the rotary magnetic field, the general design of the induction motor, and the construction of its field winding and its armature winding.—*Elec. Age,* Jan.

Measuring the Armature Resistance of Direct-Current Dynamos.—WETTLER.—A mathematical article illustrated by diagrams, on the measurement of the armature resistance by means of the Thomson double bridge. One way of using it is to apply the current at only two certain points, to which at the same time the voltage wires are connected. He gives a general formula which holds good for all kinds of windings, and which enables one to determine easily the two segments to which the current wires and voltage wires of the double bridge are to be connected.—*Elek. Zeit.,* Jan. 2.

Direct-Current Dynamos.—An illustrated description and account of tests of the 500-volt, 1100-kw dynamos for the Bolton lighting and traction plant.—Lond. *Elec. Eng.,* Jan. 24; *Elec. Times,* Jan. 23.

Tramway Generator.—NIETHAMMER.—An illustrated description of a 1000-kw tramway generator, built by the Union Electric Company, of Berlin, for a British plant.—*Elek. Zeit.,* Jan. 16.

British Dynamos.—An illustrated description of direct-current dynamos and controllers for crane work, made by Royce, Manchester.—Lond. *Elec. Rev.,* Jan. 17.

LIGHTS AND LIGHTING.

Osmium Lamp.—GABRIEL.—His Vienna Elec. Soc. paper in full, an abstract of which was recently noticed in the Digest. Gabriel is the chief engineer of the company, which owns the patents of Welsbach. Osmium has a specific gravity of 22.5, and is, therefore, the heaviest metal (sp. gr. of gold 19, platinum 21) Osmium is also the most refractory metal, the melting point being far above that of platinum, at about 2500 degs. C., or above. Osmium is very hard, much harder than glass. A normally burning osmium lamp gives 2.3 times as much light as a normally burning carbon filament incandescent lamp, for the same life and the same consumption of current (he evidently means energy). For the same illumination and at the same life the osmium lamp saves 55 to 60 per cent of current (evidently meaning energy). Fig. 1 gives a comparison of the osmium lamp with two

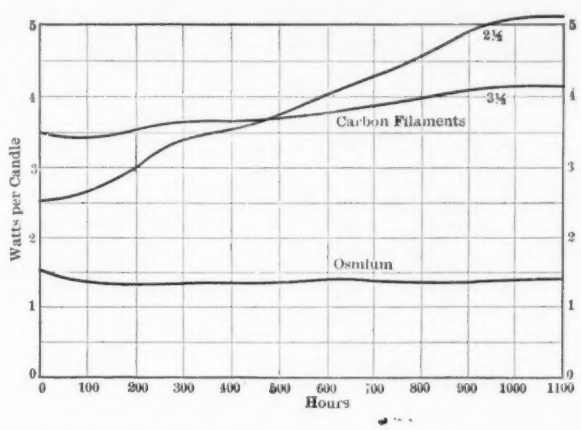


FIG. 1.—CURVES OF OSMIUM AND FILAMENT LAMPS.

carbon filament incandescent lamps, showing the economy as a function of the hours of burning. The curves are the average of a great number of tests. One of the two carbon filament lamps starts with a consumption of 2.5 watts per candle, which rapidly increases up to more than 5 watts per candle after 1000 hours. The other carbon filament lamp starts from 3.5 watts per candle; its economy is much more nearly constant. After 1000 hours it consumes 4.2 watts per candle. The average watts per candle of both carbon filament lamps, especially of that with 2½ watts initial, are considerably greater than at the start. The osmium lamp starts with 1.5 watts per candle, which decrease to 1.32 watts per candle, and then remain nearly constant. After 1000 hours 1.4 watts per candle are consumed. The average during 1000 hours is, therefore, at most 1.4 watts per candle. Fig. 2 gives a comparison of the same three lamps, showing the illumination as a function of the hours of burning. The "2½-watt per candle" carbon filament lamp gives at the start 20 candles, and at 1000 hours only 8.5 candles. The "3½-watt per candle" carbon filament lamp gives at the start about 17 candles, and after 1000 hours about 13 candles. The osmium lamp starts with 14.8 candles, then comes an increase with a maximum of 16.8 candles after 250 hours. After 1000 hours it gives 15 candles, which is still more than at the start. If the two curves of the osmium lamp in the two diagrams are considered together, it will be seen that at decreasing watts per candle,

the illumination increases or at least remains constant. He gives a table, of which the following is an abstract:

Hours	0	24	168	264	312	600	696	1032
Ampere ...	1.02	1.02	1.01	1.00	1.00	0.98	0.98	0.95
Candle	14.87	16.05	16.53	16.80	16.39	15.23	15.35	14.98
Watts cand.	1.51	1.40	1.35	1.32	1.34	1.42	1.40	1.40
Per cent....	0	7.9	11.2	13.0	9.6	2.4	3.2	0.7

The figures of this table are in agreement with the diagrams. The last line gives in per cent the increase of the candles over the candles at the beginning. (From the figures in this table it follows that the

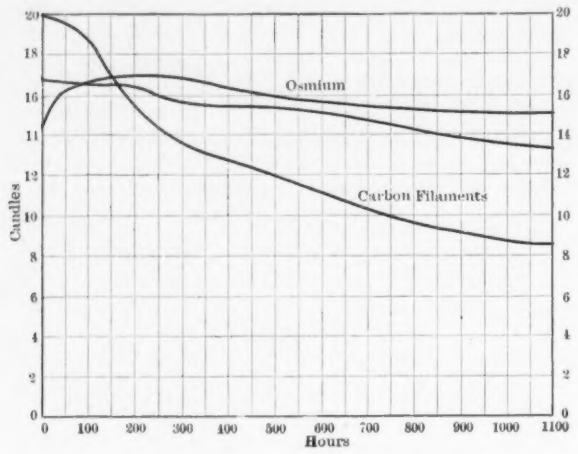


FIG. 2.—ILLUMINATION CURVES OF THREE LAMPS.

lamp tested was used on a 22-volt circuit, although this is not stated in the article). Regarding the life of the osmium lamp he says that at 1.5 watts per candle it is "scarcely shorter" than that of a good 3-watt-per-candle carbon filament lamp; at 1.5 watts per candle it has "at least the same life" as the latter; at 1.8 watts per candle the life is 1400 hours or more. It is hoped that this can be improved upon, as the development of the osmium lamp as an industrial apparatus is really only in its infancy. A disadvantage of the osmium lamp is its low voltage, they have so far only succeeded in making practical lamps up to 50 or 60 volts, due to the nature of the osmium filament which has a low resistance. One hundred-volt lamps can be made, but they are still too delicate to be used in practice. It is expected that several lamps in series will be used in existing installations. He argues that a consumer who has 10 carbon filament lamps of 16 cp always burning in his shop would not object to 10 osmium lamps of 40 cp in series, if the cost of energy is the same. In alternating-current systems the transformation to a convenient voltage is, of course, easy. He thinks that the osmium lamp will be of the greatest value for new installations, as the total plant to give a certain amount of illumination, will have to have only half the capacity required for carbon filament lamps. The osmium raw material is made into a paste by a special process and pressed into filaments under high pressure. These filaments look like ordinary threads and are soft. They are dried, and are then electrically reduced to pure metal. In the discussion which followed he said that a limited number of osmium lamps will be put on the market in the next few weeks, not for sale, but only for an annual rental fee. While in the paper itself he called the osmium lamp a "vacuum incandescent lamp," he refused to answer a question put to him in the discussion regarding the conditions of the vacuum.—*Zeit. f. Elek.*, Feb. 2.

Nernst Lamps.—Adams.—An article on the practical value of Nernst lamps. He reaches the following conclusions: "For street lighting the Nernst lamp is not generally suited, because it is impracticable to operate it on series circuits, and because its efficiency is materially below that of series arcs. For divided indoor lighting, Nernst lamps are less suitable than incandescent lamps, because of the larger first cost, fixed charges and energy consumption of the former in the smallest units. Where large interior spaces are to have general illumination, the Nernst lamp has some advantage over the incandescent in the quality of its light and over the arc in the weight of conductors necessary. This advantage over arcs seems to be fully offset by the lower Nernst efficiency."—*Sc. Amer.*, Feb. 8.

POWER

REFERENCES.

Electric Gear for Operating Gates.—In a continuation of an article on the North Sea Canal, the Ymuiden locks and the port of Amsterdam, an illustrated description is given of the electrical gear for operating gates of the Ymuiden locks. They are operated by series wound motors.—Lond. *Eng'ing*, Jan. 24.

Hoisting Machinery.—Horner.—An illustrated article on hydraulic wharf cranes, steam and electric jib cranes, locomotive cranes and general hoisting machinery.—*Cassier's Mag.*, Feb.

TRACTION.

Negative Boosters.—Kapp.—A paper, read before the Elektrotechnical Society, of Berlin, "On a new method for diminishing the drop of voltage in the rail in electric tramways with the rails used for the return current." He first refers to his older method which has been used in practice in many cases in England. This older method consists in inserting negative boosters in return feeders connected to various points of the rails. These boosters "suck" the current back from the rails. They are excited by current in the positive feeders, so that the sucking effect of the return feeders is at any moment proportional to the load at that place. The most extensive application of this method has been made at Glasgow, where in several substations more than a dozen such boosters are in use, each for 1000 amperes. The difference of voltage between the various feeding points of the rails there is not more than one volt. Such an exact regulation is, however, required only in cities with a large subdivided network of gas and water pipes, and, as in such cases, the railway network also has many branches, the cost of the special return feeders for the rails and of the boosters is not very great compared with the total first cost of installation. It is different with a straight line of considerable length, like an interurban railway, which is to be supplied with current from one terminal. In this case the cost of the special return feeders for the rails would be prohibitive. For such cases he now recommends inserting boosters directly into the rails at different points. An important point which determines the danger of stray currents escaping from the rails into the earth is the "theoretical potential of the rails," i. e., that potential which would exist at any point of the rails if no current would es-

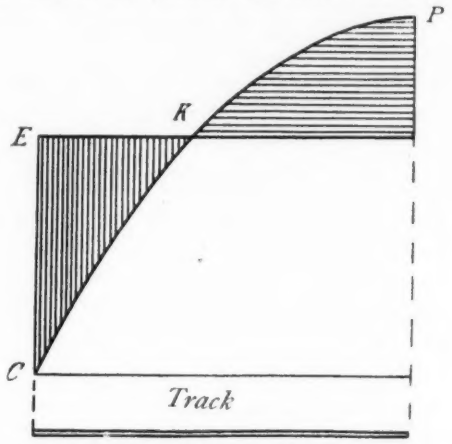


FIG. 1.—NEGATIVE BOOSTER.

cape from the rails. The curve of this theoretical potential of the rails is the curve $C\,K\,P$ in Fig. 1, which is a parabola. If now the point K is determined in such a way, that when a horizontal line is drawn through it parallel to the axis of abscissas, the two cross-hatched areas are equal, then the straight line through E represents the earth potential. The point K is at a distance $0.42 \times l$ kilometer from the central station at C, in which l is the length of the road. If a gas or water pipe is parallel to the road, then at points at the left

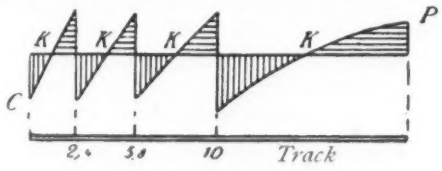


FIG. 2.—NEGATIVE BOOSTER.

hand of K the pipe is liable to corrode by electrolytic action of the stray currents, while at points at the right hand of K the rails are liable to corrosion. He remarks that "there is the same danger for

pipe and rail. One generally speaks only of the danger of the stray currents for the pipes of the gas and water companies, but one forgets that this danger cannot exist, without the same danger for the railroad company itself. If at one point a pipe is destroyed, there must be another point at which the rail is destroyed." In the present case there is such a danger. He suggests leaving out the rail joints at one or several places, and to bridge the opening by inserting a small booster with series excitation. The result is that the curve *C P* of Fig. 1 is changed into the form of Fig. 2, and the potential differences as well as the length of the dangerous zones are greatly reduced. The arrangement of such a booster is represented in Fig. 3. *G*

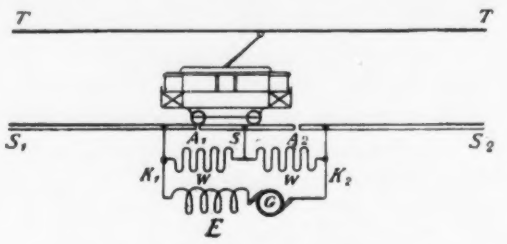


FIG. 3.—ARRANGEMENT OF BOOSTER.

is the armature, *F* the exciter winding, and *W W* are permanent resistances. The rails are electrically disconnected at A_1 and A_2, and the length $A_1 A_2$ is greater than the distance between the first and last wheel of the car. The rail *S*, between A_1 and A_2, is connected to the central point of the permanent resistance. The booster is driven by a motor connected to the overhead wire and the rails. The purpose of the resistance *W* is to enable the car to start, when by chance it has stopped on the part *S*. If that happens only occasionally, and if the ground conducts well, *W* may be omitted. The booster is placed in a small cabin near the road and does not need continuous attendance. A booster arrangement for alternating currents is also given, but in the discussion which followed Dolivo-Dobrowolski showed that Kapp's arrangement for alternating currents would not work. In a communication of Dobrowolski, published in the same issue, this criticism is dealt with in greater detail.—*Elek. Zeit.*, Jan. 2.

British Tramway Statistics.—The large annual table of statistics for 1901, of electric railways and tramways in the United Kingdom, in operation and "in progress," giving a large amount of valuable statistical information. There is also an editorial summary. In addition to large extensions made to the networks of electric tramways previously existing, 27 new electric lines have been opened to the public in various parts of the United Kingdom, bringing the total number of these undertakings up to 85. There are 45 more being constructed or are undergoing conversion from horse service to electricity, the corresponding figure of last year having been 29. The tramway branch of the "heavy" electrical industry is now regarded as the most promising one for the moment in Great Britain. A large proportion of the new electric tramways are municipal undertakings. —Lond. *Elec.*, Jan. 24.

REFERENCES.

Trials of Electric Operation on German Main Railroads.—SPAENGLER.—The first part of a long illustrated paper in which he discusses several trials made in Germany. This part deals with Siemens & Halske's experiments on their trial road, and with the trials of the Wannsee railroad, which have been mentioned before at length in the Digest.—*Zeit. Oest. Ing. and Arch. Ver.*, Jan. 17.

Guard Wires in Electric Traction Installations.—A reprint of the new rules proposed by the Brit. Board of Trade.—Lond. *Elec.*, Jan. 17.

Multiple Unit System.—BLACKSTONE.—The first part of a long, well illustrated article on the different systems of multiple unit control of trains.—*L'Eclairage Elec.*, Jan. 25.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

German Combined Traction and Lighting Plant.—LEISSE.—An illustrated article on the electric plants in Rheydt and Gladbach. Between both cities there had been a horse car service. When it was decided to change over to electric opration, the purpose was to combine it with electric light and power service in both cities. In order to be able to use the three-wire direct-current system at 2×220 volts, each city put in its own plant. The plant in Rheydt is described. It contains the steam-driven generators. When running at 92 revolutions, each gives 360 amperes at 480 volts, for light and power purposes; when running at 100 revolutions, each gives 300 amperes at 550 volts for traction. There are two storage batteries—the one for the light and power service has a capacity of 648 ampere-hours if discharged in 3 hours, the other, for the traction system, gives 200 ampere-hours if discharged in 1 hour.—*Elek. Zeit.*, Jan. 2.

REFERENCE.

Supply Regulations.—A reprint of the regulations drafted by Wordingham on the regulations for the supply of electrical energy in the area of the Stretford District Council.—Lond. *Elec. Eng.*, Jan. 17.

WIRES, WIRING AND CONDUITS.

Three-Phase Circuits.—TEICHMUELLER.—A long mathematical article, illustrated by many diagrams, on the calculation of "elastic three-phase circuits." He first gives some general notes on vector-diagrams, and then discusses three-phase circuits with delta connection of the receiving apparatus, and also with star connection, with a neutral wire. He calculates the wires for uniform load on the phases for a certain loss in the line, and discusses the influence of differences of load in the different phases. He finally gives a comparison of the copper required in different systems under different conditions. What he considers to be the fairest comparison, relates to the case of unequal load of the phases or halves of the system, the load different in one phase in percentage of the total load being the same in all cases; then if the copper required by the two-wire system is 100, the copper required by the threee-phase system with star-connected and with neutral wire of a cross-section equal to one-half the cross-section of the other wires, is 58.33; the copper required by the three-phase system with delta connection, is 75; the copper required by the "three-wire" system, with a middle wire of half the cross-section of the outer wires, is 41.67.—*Elek. Zeit.*, Jan. 2, 9.

Cable Industry in Germany.—O'GORMAN.—Some notes comparing the cable industry in Germany with that in Great Britain. He regrets that most cable factories resort to secret compounds and processes. The universal prevalence of the lead covering shows that no water-proof substance has yet been found. The essentially technical improvement in which the German cable industry is slightly ahead of the British, is the adoption of vacuum drying, and vacuum impregnating tanks. In order to reduce the very large stocks of copper wire which cable makers have to carry owing to the large number of difficult sizes and styles of cable required, the Germans have installed wire-drawing mills and purchase only one or two stock sizes of copper wire, so that the variety of demand may be met without the delay of waiting for the wire drawers' delivery, and yet without carrying a multiplicity of different sizes in large quantity. Furthermore, there is an incidental economy in the operations of winding and measuring. In general, the German cable industry is not ahead of the British, but is making important advance.—Lond. *Elec. Rev.*, Jan. 17.

REFERENCE.

India Rubber.—WICKHAM.—An illustrated article on the Hoevia, "Para," Indian rubber, and on the origin of the introduction and cultivation of the tree.—Lond. *Elec. Eng.*, Jan. 10.

ELECTRO-PHYSICS AND MAGNETISM.

Hysteresis.—DINA.—An account of an experimental investigation in which he compared the three different kinds of magnetic hysteresis in iron. In the static hysteresis and the alternating-current hysteresis, the magnetizing force has a constant direction but a variable value, but a cycle in the former takes place slowly step by step (ballistic and magnetometric method), while in the latter it occurs quickly and continually (in the transformers). On the other hand, in the "rotating hysteresis" the magnetizing force has a constant value and variable direction, and a cycle is completed in a short time (in dynamos). He determined the rotating hysteresis as follows: A coil made of thin insulated wire was revolved in a magnetic field, and from measurements of the resistance of the wire, the increase of temperature and the hysteresis energy were determined. He afterward also used the ballistic method and also determined the alternating-current hysteresis. The general result is that rotation diminishes the hysteresis loss, while an increase of the speed at which a cycle is completed, increases these losses. At relatively low inductions, the second influence is the more important one, at higher inductions, it is the first. In the iron investigated by him up to $B = 10{,}000$, the rotating hysteresis is greater than the static, but smaller than the alternating-current hysteresis. Above this induction it is smaller than the other two.—*Elek. Zeit.*, Jan. 18.

REFERENCES.

Absorption of Röntgen Rays.—McChung and McIntosh.—An account of an experimental investigation of the absorption of Röntgen rays by aqueous solutions. An increase in the amount of salt in solution produces an increase in the absorption; but there is no proportionality. The relation appears to be a logarithmic one. The absorption depends upon two factors, the cation and the anion.—*Phil. Mag.*, Jan.

Hydrogen Peroxide.—D'Arcy.—An account of an experimental investigation of the decomposition of hydrogen peroxide by light, and the electrical discharging action of this decomposition.—*Phil. Mag.*, Jan.

Magnetic Induction and Magnetic Force.—Muellendorf.—A mathematical article with several tables. As has been noticed in the Digest, he has formerly developed from theoretical considerations two different formulas for the relations between magnetic induction and magnetizing forces. In this article he examines both formulas with reference to the degree to which they agree with magnetizing curves determined by Kapp. As neither agrees entirely with these curves, he modifies one of his formulas by introducing another constant.—*Elek. Zeit.*, Jan. 9.

Electro-Chemistry and Batteries.

Spongy Tin and Tin Crystals by Electrolysis of Aqueous Solutions.—Pfamhauser.—An account of an investigation of the conditions under which spongy tin or tin crystals are deposited from aqueous solutions. When electrolyzing highly concentrated solutions of stannic chloride and stannous chloride, he found that for higher concentrations than a normal solution, the formation of spongy tin ceases entirely only at smaller current densities, while at current densities above 1 ampere per square decimeter formation of crystallized tin took place. When the electrolyte contains sodium ions or potassium ions or generally cations which form strongly dissociated solutions at the cathodes these ions accumulate at the cathode, but cannot be deposited, as the voltage is not sufficient. The tin ions must then pass through the solution of potassium hydroxide, etc., and can reach the cathode only at isolated points, so that the formation of a tin tree sets in and this is the beginning of the formation of spongy tin. The formation of spongy tin is, therefore, evidently avoided by proper stirring or circulation. The deposition of tin in thick layers is only possible with highly concentrated solutions of tin salts containing no cations (like K, Na), which can form strongly dissociated solutions around the cathode. It is also necessary that there are always enough tin ions at the cathode, and for this reason a small current density and stirring are necessary.—*Zeit. f. Elektrochemie*, Jan. 16.

Nitric Acid.—Veley and Manley.—A brief summary of an experimental investigation of the ionic and thermal coefficients of nitric acid, for greatly changing concentrations. Nitric acid is like other electrolytes in possessing a positive temperature-coefficient for concentrations up to 96 per cent, yet beyond this point it behaves as a metallic conductor in possessing a negative temperature-coefficient. This phenomenon cannot be explained by the aid of the ionic dissociation theory. They have observed a similar abnormality in other physical properties, and especially in the contractions. Kohlrausch and Hallwachs have pointed out that there is an undoubted relation between the contraction, produced even in very dilute solutions of electrolytes and ionic dissociations, since non-electrolytes do not show this phenomenon. In the present instance, though the points of alteration of direction of curvature are the same, both for the contractions and the quotient of ionic dissociation, if expressed in terms of percentages, yet the correlation of the two phenomena does not appear to be of a simple character.—*Phil. Mag.*, Jan.

Internal Resistance of Galvanic Cells.—Ayres.—An illustrated account of measurements of the true internal resistance of galvanic cells by means of a "capacity bridge" method, which is a new modification of Kohlrausch's method. The method gives not only the resistance but also the capacity of the cell. A complete mathematical theory of the bridge is given. Experiments were made with Daniell cells, "Excello" cells and Leclanche cells. The results show that the resistance was the same whether the cell was on open or closed circuit, within high limits of accuracy. However, it is to be noted that the condition of a cell, of course, depends upon its previous history, among other things upon any prolonged current that may have been flowing, in so far as this actually alters the cell. What his results show is that the resistance of a cell is not a function of the current at the time.—*Phys. Rev.*, Jan.

Polarization of Magnesium.—Campetti.—An account of experiments in which he used a magnesium anode in the same way in which the aluminum anode has been used at repeated times for rectifying alternating currents. He used a magnesium anode, a platinum cathode, and a solution of caustic soda. He found that the current passing through the cell is very small until a potential difference of 75 volts is reached when there is a rapid evolution of gas and a strong current. "When the platinum is made anode the current is about 30 times as strong. It appears that 10 or 15 per cent of the energy transmitted through the cell is used up in overcoming the resistance of the boundary between the electrodes and the liquid."—*Nuovo Cimento*, Oct.; abstracted in Lond. *Elec.*, Jan. 10.

REFERENCES.

Scrap Tin.—An illustrated summary of numerous recent improvements and modifications of electrolytic methods for obtaining tin from scrap tin.—*Zeit. f. Elektrochemie*, Jan. 9.

Electro-Chemistry in 1901.—Krueger.—The first part of a very condensed summary. This part gives a brief review of articles on theoretical chemistry.—*Electrochem. Zeit.*, Jan.

Dielectric Constant of Solutions.—De Forest Palmer.—A long illustrated account of an experimental investigation of the dependency of the dielectric constant of dilute electrolytic solutions, upon the concentration.—*Phys. Rev.*, Jan.

Electrolytic Production of Chlorates.—J. B. C. Kershaw.—An illustrated description of the Corbin process and cell for the electrolytic production of chlorates, as used in Chedde in Savoy, since 1896. Water power is utilized, the mean annual power being from 8000 to 9000. The construction of the cell is described and illustrated. A current efficiency of 85 per cent is attained. The output of chlorate and perchlorate has increased from 2200 tons in 1899 to 4000 tons in 1900.—Lond. *Elec. Rev.*, Jan. 17.

Units, Measurements and Instruments.

Frequency Measurements.—K. E. F. Schmidt.—A description of several methods of measuring the frequencies of alternating currents. In one of these a telephone is made to produce stationary sound waves in a glass tube, and two positions of minimum resonance are determined by means of a piston. The telephone is excited by the current to be studied, and the position of the piston together with the known velocity of the sound in the air, suffice to determine the frequency sought. He has also successfully used Kundt's dust figures for the same purpose. Both methods are suitable only for frequencies which are considerably higher than those ordinarily used. For ordinary frequencies he uses an incandescent lamp fed by the current under investigation. This is photographed by a camera attached to a pendulum and the negatives show alternate bright and dull stripes in accordance with the maxima and minima of the current traversing the lamp. He also simultaneously photographed two lamps in this manner, one of which had a difference of phase with respect to the other. This phase difference then expresses itself in a displacement of the stripes with respect to each other.—*Ann. der Physik*, No. 1; abstracted in Lond. *Elec.*, Jan. 17.

REFERENCES.

Registering Instruments on Tramways and Railways.—Jacquis.—A long illustrated description of various registering instruments for use on tramways and railways. The results of tests of two French railway companies are also given at some length, in which the e. m. f. at the lamps was registered, the lighting current being furnished from dynamos connected to the wheels in parallel with a battery.—*L'Eclairage Elec.*, Jan. 4, 18.

Voltameter.—Lehfeldt.—His Phys. Soc. paper on a voltameter for small currents, an abstract of which has been noticed before in the Digest.—*Phil. Mag*, Jan.

Wattmeters.—Armagnat.—The first part of an article, illustrated by many diagrams, on the theory and construction of wattmeters. In this part he deals with electrodynamic wattmeters and discusses the effects of mutual induction and of self-induction.—*L'Ind. Elec.*, Jan. 10.

Electrograph.—An illustrated description of the electrograph devised by Lancetta, in which the property of imperfect contacts is applied to the registration of disturbances of atmospheric electricity and especially to the observation of the progress of distant storms.—Lond. *Elec. Rev.*, Jan. 17.

Cable Testing.—SAVAGE.—The first part of an article illustrated by diagrams in which he discusses the methods used in practice for eliminating corrections for the leads, etc., in cable testing.—Lond. *Elec. Rev.*, Jan. 17.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—FERRIE.—A long abstract of a paper read before the Internat. Soc. of Elec. in Paris. After a review of the development of wireless telegraphy he discusses the part which the vertical wires play, and also the earth. He has found that the Hertzian field is concentrated immediately above the ground, so that the earth plays a part in the transmission as it prevents the field from being dissipated into all the space. He also discusses the methods of syntonizing, and the action of the coherer. The disadvantages of wireles telegraphy are uncertainty, depending upon atmospheric disturbances, lack of secrecy, and low speed of transmission. Nevertheless, wireless telegraphy has great advantages for transmission from ship to ship and from ship to coast, especially in war times, when it may also be used by the army. He does not believe that in other ways wireless telegraphy will ever be able to compete commercially with ordinary telegraphy.—*L'Eclairage Elec.*, Jan. 18.

REFERENCE.

Submarine Cable.—MASCART.—An illustrated article on the submarine cable between Tourane, Annam, and Amoy, China, which is the first French cable in the Orient. The construction of the cable and the installation of the cable ship are described.—*Rev. Gen. des Sc.*, Jan. 15.

MISCELLANEOUS.

Physiological Effect of High-Frequency Currents.—BORDIER and LECOMTE.—An account of experiments on the probable reason why high frequency currents, as used in Tesla's experiments, are under certain conditions harmless when applied to the human body. The prevailing idea has been that the currents pass over the surface of the body without affecting the vital organs. This is contradicted by the present authors who tried the effects of an induction coil worked by a continuous current of 120 volts and a Wehnelt interrupter upon a guinea pig, a rabbit and a rat. The rat died immediately, the guinea pig died in seven minutes and the rabbit after 13 minutes. Under the same conditions a human subject did not experience the slightest sensation. D'Arsonval in reviewing these results points out that the physiological effect is entirely due to heating, which leads to a coagulation of the blood. This heating is small in the case of the human body, and, therefore, harmless.—*Comptes Rendus*, Dec. 30; abstracted in Lond. *Elec.*, Jan. 17.

Earth Plates.—TANAKADATE.—An article on earth plates which are used for diminishing the resistance of telegraph circuits, lightning conductors, etc. While it is often assumed that the efficiency of such plates is measured by their area, he shows mathematically that great economy of material may be effected by using elongated strips instead of square or round plates. Roughly speaking, a strip of 1 cm. by 5 meters will be enough to replace a plate of 1 square meter, i. e., one-twentieth of the material will suffice. As regards corrosion, more damage may be done by a long, narrow fault than by a round one of the same area.—*Denkigakkwai Zassi*, No. 159; abstracted in Lond. *Elec.*, Jan. 10.

REFERENCES.

British Engineers in Germany.—The reports to the Brit. Inst. Elec. Eng. on last year's visit to Germany, by the committee on manufacturing, dealing with the financial conditions of the electrical industry in Germany, the works, management, and the design, etc., also the report of the committee on telegraphs and telephones, also a full record of the discussion of the reports before the Institute.—Lond. *Elec.*, Jan. 17.

Glasgow Exhibition.—BATHURST.—A continuation of his illustrated description of machine tools at the Glasgow Exposition with special reference to needs of electrical manufacturers. This part deals with new hexagon turret lathes.—Lond. *Elec Rev.*, Jan. 17.

Marconi's Return to America.

A special cable dispatch from London, Feb. 14, states that Mr. Marconi will return to the United States in 10 days to resume his transatlantic experiments.

New Books.

VELOCITY DIAGRAMS. Their Construction and Their Uses. By Chas. W. MacCord, A. M., Sc. D. New York: John Wiley & Sons. 116 pages, 83 illustrations. Price, cloth, $1.50.

The author says in his preface, "This treatise is in effect an abstract of a series of lectures forming a part of the course of instruction of the Stevens Institute of Technology." It is written in a manner, however, that is satisfactory to the student who is studying without an instructor.

In the operation of any piece of mechanism each part goes through a complete series or cycle of motions, and then returns to its initial position. The graphical deliniation of such a cycle is called a velocity diagram. The book takes up the subject at the beginning and extends it to a sufficient number of practical cases, so that the student can become familiar with the method and be able to apply it to new cases as they occur in his work.

In expounding the method of Roberval for drawing tangents the author becomes somewhat polemical, and devotes two or three pages to demolishing the statements of Mr. J. F. Heather in his descriptive geometry. He proves his case, but it is scarcely necessary in a work of this class to bring in incorrect statements for the purpose of disproving them. A demonstration of the correct method is sufficient. We can recommend the book to students of machine design and others interested in mechanical movements.

THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson. Second Edition, rewritten and enlarged. New York: The Macmillan Company. 333 pages, 238 illustrations. Price, $1.75.

The first edition of Professor Franklin's book was issued in September, 1899, and that a second edition is now called for is an indication of the reception that has been given this text-book. This second edition is in effect a new book, for, besides containing 50 per cent more matter, much of the original text has been rewritten. The authors evidently concluded that as first issued the book partook too greatly of class exercises, for the matter which they have added is rather of a general and descriptive character. The added topics deal with the discussion of the relative advantages and disadvantages of alternating currents, and the characteristic features of the problems involved in such current working, though, as stated here, many of the claims are not convincing, and the entire discussion is far from satisfactory.

A very clear and simple statement of the nature and specific problems of electrical resonance has been added, and supplementing the more theoretical discussions is a new section devoted to the description of alternating-current machinery. In these latter five chapters are given excellent selections from standard catalogue matter, with illustrations and diagrams whose originality has emanated from the draughting rooms of the several large electrical companies. This is one of the constantly recurring complaints of reviewers, and authors seem to be as industriously continuing in the path of least resistance, which, in this case, is the binding of catalogue matter between boards and offering it as a book. Under the circumstances an author is dependent upon the voluminous catalogue literature for many of the essential details of the commercial apparatus which he must describe; but it is the privilege of the reader to demand a vital and individual presentation of such details in a work of authority.

The publisher, too, is to be criticized for numerous typographical defects. The table of contents is a surprise, as it is set up in "display." Both the paper and letter press are excellent, though the latter is frequently marred by the unusually large diagrams, as on page 122, and by the excessive size of the half-tone illustrations of apparatus, and the failure of the printer to bring these out with clearness. On page 278 a section of an armature is shown which would have been equally effective in a much smaller cut. These are pronounced defects which have spoiled the appearance of an otherwise typographically excellent book.

For the general reader, as well as the student, Professor Franklin's Elements of Alternating Currents is decidedly the best book available in English, both in respect to the scope of the subject matter treated, and the general development of the discussions. Its superiority over the excellent work of Messrs. Jackson is due to its clearness of treatment and grasp of essential physical relations. The writer here is in full and trained command of the mathematical

tool, and it does not dominate him to the detriment of the work. American readers will no doubt find more of interest and real value in it than in the works of Fleming and Thompson.

The book is distinctly inferior in mathematical method when compared with the treatment given alternating currents by Bedell and Crehore and Blakesley. On the other hand, aside from the logical treatment of the subject matter, the work of Bedell and Crehore is so destitute of physical significance and value that it should not be compared with this more matured and masterful work of Professor Franklin.

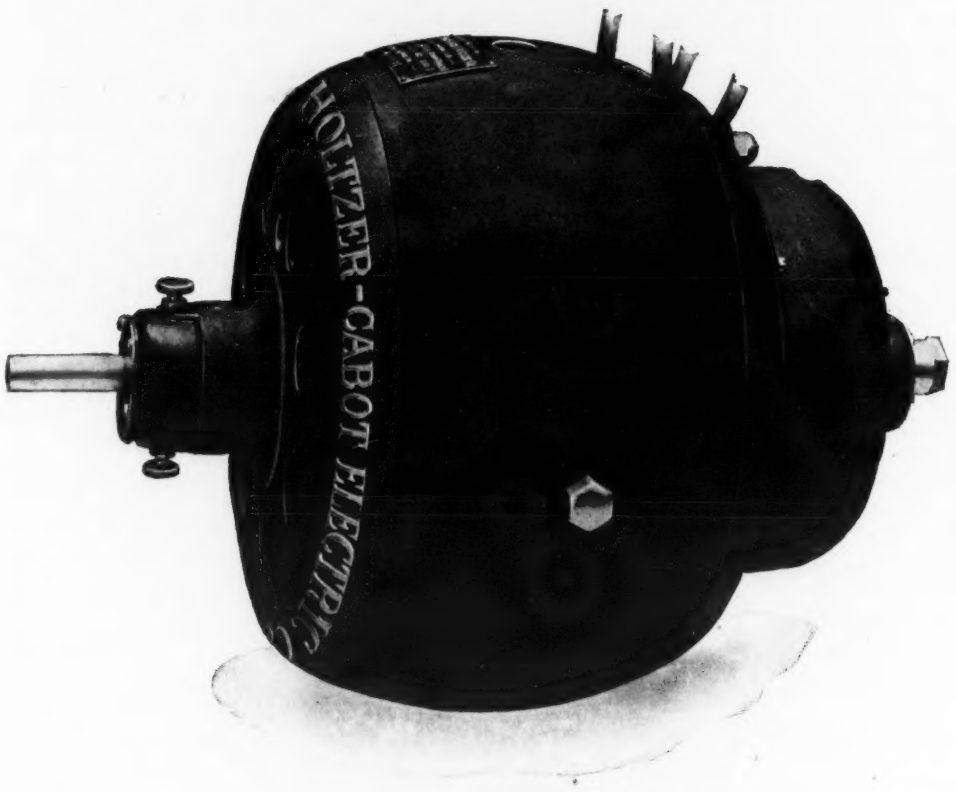
In Chapter LII. one feels disappointed that the authors have adhered to a geometrical method of discussion, when the only satisfactory one to pursue is the purely analytical. This same stricture may be applied nearly to all the purely theoretical portions of the text. The work is also lacking in physical explanation of electromagnetic phenomena of a periodic character. This is especially noticeable in the discussions of capacitance, reactance and inductance, as these concepts occur from time to time. As a whole, the style of the book is clear and forceful, though it often suffers from the personal emphasis of the writer and the frequent use of inconsequential headings, such as "remark" and "note," while in not a few cases iteration has been mistaken for explanation.

The text is copiously illustrated with problems. Doubtless this will yield a secret joy to those readers who are addicted to the ciphering habit; but to others it has the gruesome suggestion of the examination room. The matter of problems might have been left to works on electrical calculations.

The most impressive portions of the book are the three chapters which deal with the synchronous and induction motors, and the rotary transformer. No author has yet given these subjects such a clear and satisfactory treatment. As a whole, Professor Franklin is to be congratulated on the great excellence of this new edition of his book, and it is a conspicuous addition to the list of the few really good electrical books which American scholarship has produced.

The Development of Launch Motors.

In the accompanying illustration is shown a ½-hp motor, which is



LAUNCH MOTOR.

one of a line constructed especially for launch work by the Holtzer-Cabot Electric Company, of Boston. As will be observed, the motor is entirely enclosed, being practically moisture proof. If the motor is well protected or is to be used in fresh water, the weight is materially decreased by the use of aluminum in parts where other metals are not necessary for electrical or magnetic purposes, although if the motor is likely to be exposed to the salt water, brass or iron fittings are recommended because of the corrosive action of the salt water upon the aluminum. In the latter case, the finished parts of the machine are copper plated for the same reason. The shape of the frame is such that two equal paths are provided for the magnetic flux, one on either side of the armature, a design which allows of great compactness.

The brush holder used with these motors is of the box type with parallel feed, making it impossible to run the motor for a long period of time without any attention to the brushes. A special form is used, consisting of stratifications of woven copper gauze and carbon, the outside layers being of the latter substance with a heavy copper plate. In this way are secured the advantages of the high conductivity of the copper and the wearing qualities of the carbon, the latter also preventing the copper gauze from spreading out and sticking in the holder.

The machines are economical in operation. The speed is low, 1000 r. p. m., and as they are series wound, they use field energy only in proportion to the load. The voltage is usually low, from 20 to 40 being ample in most cases. The motor is usually supported in the stern of the boat by means of heavy braces which are bolted to the body of the motor.

An Improved Theater Dimmer.

The increasing demand for more and better stage lighting effects has brought into prominence a type of theater dimmer manufactured by the Wirt Electric Company, of Philadelphia. The usual disadvantage accompanying dimmer operation is lack of space for installing the apparatus. To circumvent this difficulty it is customary to curtail the dimmer outfit and accommodate it to the available space. As a result, the apparatus generally lacks in some essential points.

The desirability of placing the stage dimmer at the first entrance implies small space, and recommends that dimmer which is the most compact while at the same time most complete.

The present method of furnishing three colors throughout all stage circuits demands a dimmer outfit of great flexibility. The operator wishes to combine the various colors and the various circuits in every possible way, and to accomplish this the only satisfactory method is to furnish for each color an individual dimmer. By this arrangement the operation of the board may be greatly simplified, and the possible combinations for producing light effects considerably increased. For example, if a sunset effect is desired, the usual method to accomplish this heretofore has been to first raise the red lights while the white lights are bright, and then dim the white lights by throwing the red light dimmer on the white light circuit. This is undesirable, since the stage is momentarily illuminated to an unusual brightness, owing to the superposition of the red lights on the white. Then, when the white lights are thrown out there remains a disagreeable impression of darkness, and this is particularly intensified, owing to the fact that there are usually a less number of colored lights in the circuit than there are white lights.

Another disadvantage arising from this method is the likelihood of mistakes in operation, owing to the complication of switches to enable the proper combinations to be made with a limited number of dimmers; in fact, an experienced operator is needed to manipulate such a board with certainty. To avoid this, a dimmer should be placed on each circuit and means provided for gradually dimming one set of

circuits at the same time that another set is being raised. Reference to the illustrations will show in what manner this is accomplished with the Wirt dimmer. Fig. 1 illustrates a bank of 24 stage dimmers arranged on three horizontal shafts, each shaft for a color; the white lights on the top shaft, red lights on the middle shaft, and blue lights on the bottom shaft. Each one of these 24 operating levers may be independently adjusted, or any combination of levers on a single shaft may be simultaneously controlled by means of one of the master levers shown at the right.

This board is intended to go on the left side of the stage, and, consequently, the arrangement of dimmer circuits from right to left is as follows: On the top shaft, white lights, proscenium, foots, first border, second border, third border, fourth border, fifth border,

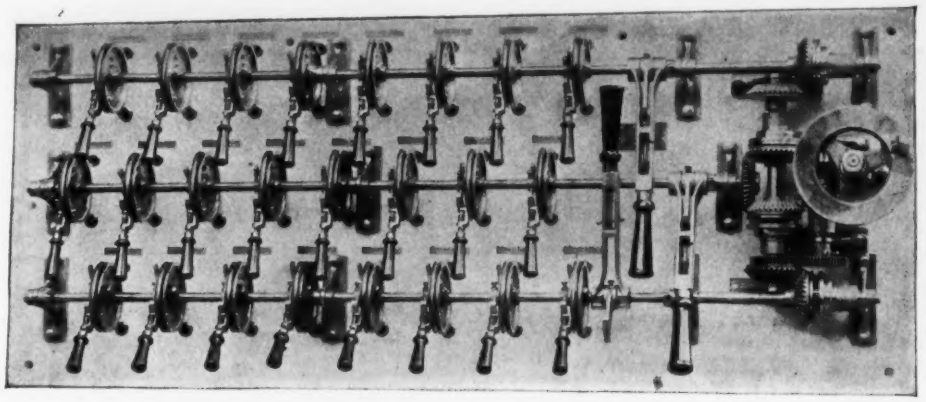


FIG. 1.—24 STAGE DIMMERS.

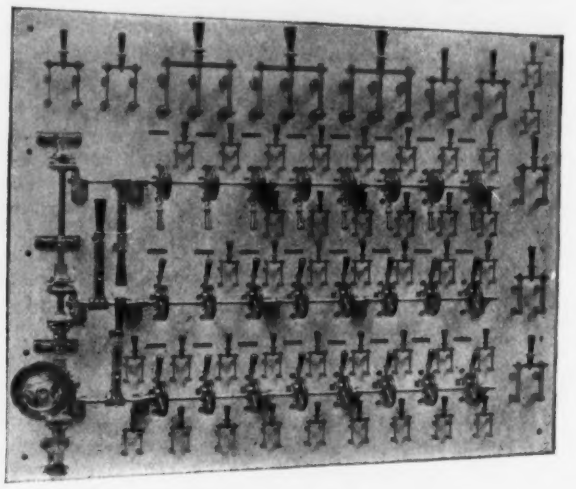


FIG. 2.—ANOTHER FORM OF DIMMER.

auditorium. On the middle shaft, white lights and auditorium are displaced by red lights and bunch lights, and on the bottom shaft blue lights displace red lights, the other lights being the same on the several shafts.

With the individual dimmers operated by the levers, as above noted, it is a very simple matter to secure any combinations of light on any one shaft, and to operate any pair of shafts in the same or opposite direction at the same time.

To aid in securing a gradual light variation in dimming one color or dissolving two colors, a vertical gang shaft with worm gear is supplied that may be engaged or disengaged with one or all of the horizontal shafts. In the improved form, the horizontal shafts are engaged or disengaged by means of friction clutches which may be thrown in or out while the vertical shaft is in motion. This accomplishes a most important function. It enables one color to be thrown

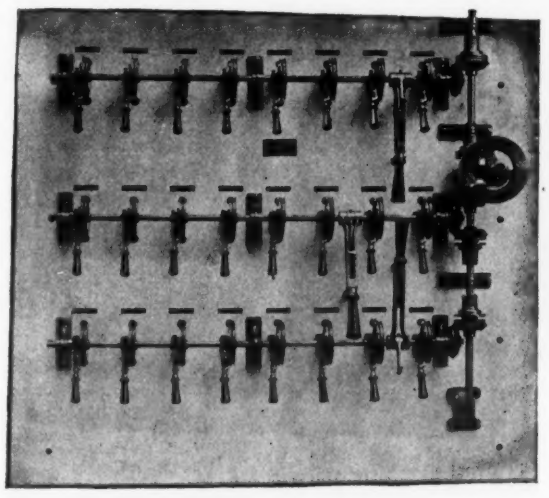


FIG. 3.—STAGE DIMMER.

on the gang shaft at any time after another color has been thrown on and in the reverse direction, and this is accomplished without stopping the motion of the gang shaft or of the lights that are being raised. If, now, it is desired to produce a sunset effect, the first operation is to engage the horizontal interlocking shaft controlling the red lights with the vertical gang shaft and start the worm wheel. This will gradually raise the red lights. When they have been raised a small amount, the horizontal shaft controlling the white lights is engaged with the vertical shaft by means of its friction clutch, and he dimming of the white lights is begun. When the red lights have been raised to their full candle-power, they are thrown off of the gang shaft, and the dimming of the white lights is completed.

If now it is desired to secure a moonlight effect, a similar operation is performed with the red and blue lights. Owing to the easy operation of these levers and shafts, dark changes may be made by means of the master levers, as the bank of dimmers can be almost as easily operated as a knife switch. In fact, this method of interlocking dimmers and arrangement of independent horizontal shafts removes entirely the necessity for ganging switches, a method which was almost exclusively adopted before the dimmer was perfected, and as a makeshift has outlived its usefulness.

This same type of dimmer is also made in another form wherein the branch circuit switches and main switches are also on the same panel. This is illustrated by Fig. 2. In this arrangement each dimmer lever has a corresponding switch adjacent thereto, so that the two are for controlling the same circuit.

At the extreme right of each horizontal shaft is a bull switch or break-down switch for controlling all of the stage lights on one color. This is very convenient in some instances in dark changes where it is not desired to operate the dimmers.

Another modification of this type of dimmer was made this year for the Garrick Theater, of Philadelphia. At the suggestion of Mr. Beerwald, electrician of the Garrick, the switches were placed back of the main panel and operated by levers on the front of the board. By placing these levers on the same horizontal shafts supporting the dimmer levers the control of each circuit was secured by two levers adjacent to each other, one supporting the switch and one the dimmer. The particular advantage of this form is the removal of all live parts from the face of the switchboard.

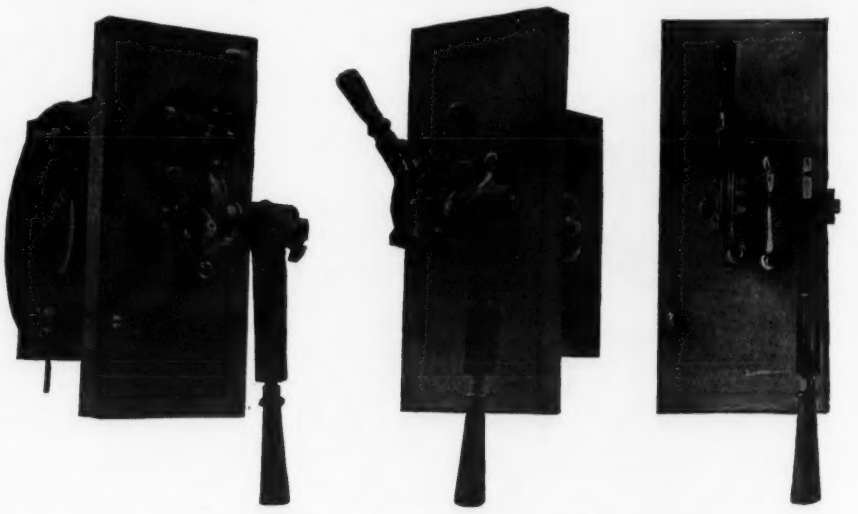


FIG. 4.—THREE VIEWS OF ONE DIMMER UNIT.

This operating board may be placed quite close to the proscenium

wall, and the dimmers proper may be situated either above the operating board, beneath the stage floor, or directly behind the board. The arrangement of dimmers beneath the stage floor is preferable, as there is always plenty of room for installing dimmers in that position, and they are easily accessible for examination or repairs.

Steel cables passing over pulleys on the operating board and through grommets in the panel turn over idlers, and pass down beneath the stage floor, where they are connected to the proper dimmers and control them. There is provided a take-up for any slack that may occur in these flexible steel cables, but it has been found after two years' use that the cables stretch very little, and the take-up device is an unnecessary refinement.

The whole operating board is preferably contained in a cabinet with sliding or rolling front, which may be closed when the board is not in use. The small size of the board enables a single operator to control every circuit and dimmer without the necessity of moving from one point to another.

Fig. 1 illustrates a board measuring approximately 2 ft. by 4 ft. 6 inches, and, as before stated, with 24 dimmer circuits. The dimmers themselves are attached to the proscenium wall above the operating board. Fig. 2 illustrates a board with dimmer plates beneath the stage floor. In the case of Fig. 3 the dimmers were directly back of the operating board. Fig. 4 represents three views of a single unit, showing the operating lever together with a portion of the interlocking shaft and master lever on the face of the board, and the dimmer plate directly back of it. As will be seen from an examination of these cuts a simple rotation of the handle of the lever is sufficient to engage it with or disengage it from the interlocking shaft. It may be set so that the interlocking shaft when rotated will pick it up at any point at which it has been left.

G. E. Fan Motors for 1902.

The fan motors manufactured by the General Electric Company for 1902 embody but slight modifications. The standard sizes this year for alternating-curent motors include 12-inch desk motors with swivel frames and with swivel and trunnion frames; 12-inch wall bracket motors; 16-inch solid frame desk motors and 16-inch wall bracket motors. The direct-current motors are made in the same sizes and styles excepting the 12-inch desk motor which is made with the solid frame and with swivel and trunnion frame. These motors are all fitted with variable speed switches. They are finished in black enamel; the fans, guards and trimmings being of polished brass. Attention is called to the fact that the guards are all fitted with two outer rings, which, besides protecting the fan, increases the stiffness of the guard, a precaution made necessary by the rough handling to which motors are often subjected.

Beside the standard line of desk and wall bracket fan motors, this

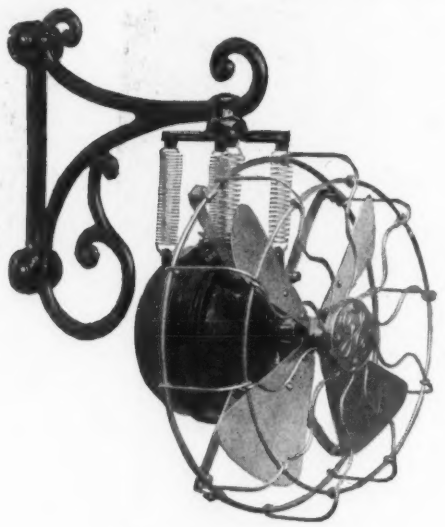


FIG. 1.—BRACKET FAN.

company presents a special spring supported bracket motor of ornamental design using a 10-inch fan. On account of its noiseless operation and attractive appearance, this motor is intended specially for private residences and sleeping apartments, particularly when the motor must be placed on walls or partitions where the vibration tends to make the operation of solidly supported motors noisy and unsatisfactory. These motors are made for both direct and alternating-current circuits.

The 1902 ceiling fan is a four-blade fan, with 58-inch sweep of blade, furnished with black enamel or oxidized copper casing. A decidedly novel and attractive type is the radial fan motor made for 115-volt direct-current circuits, and intended for such places as dining and reading rooms, where a gentle horizontal breeze in all direc-

FIG. 2.—RADIAL FAN.

tions is especially desirable. This device is 24 inches high; a six-blade fan 8 inches in diameter being used and protected by a suitable guard. A three-speed switch is provided in the base of the motor, which is connected to the circuit in the usual way by means of a flexible cord. It is furnished with an artistic casing finished in streaked oxidized silver.

There is another line which the General Electric Company includes

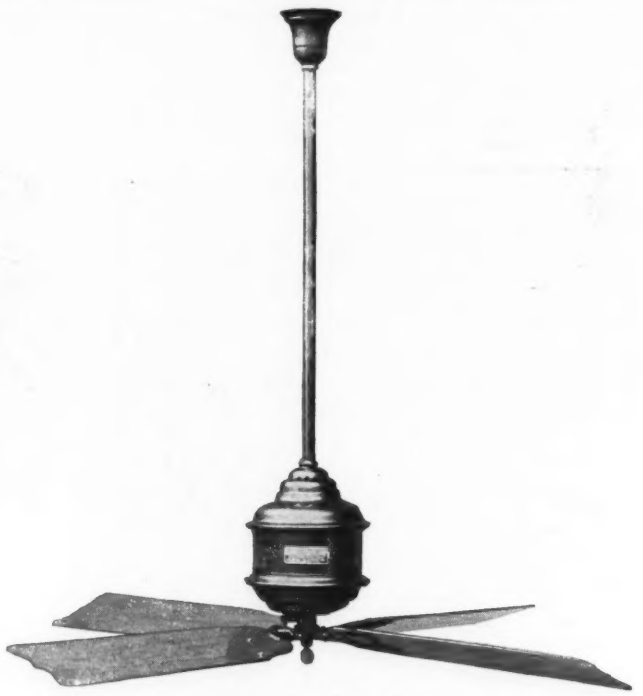


FIG. 3.—CEILING FAN.

with its fan motors this year, and known as ventilating fan motors. They consist of 12 or 16-inch fans, mounted on a tripod intended for use in openings in walls or partitions or in any place where it is desirable to remove more than about 3500 cu. feet of free air per minute. These are made for 115 volts and 230 volts direct current, and 100 to 115 volts alternating current, 60 and 125 to 140 cycles.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4 per cent for 30 to 60 days, and 4@4½ per cent for three, four and five months. Early in the week the stock market showed a broadening tendency but the threatened enforcement of the recent rulings of the Internal Revenue Department regarding the war tax in connection with securities deposited as collateral for loans, somewhat checked the market and brought on hesitation in dealings. United States Steel securities responded more or less to favorable accounts of the steel trade conditions. Amalgamated Copper was heavy throughout on the reports of a further dividend reduction, and traction securities were unfavorably affected by the news of the $150,000,000 blanket bond mortgage on the Brooklyn Rapid Transit system. The latter stock closed at 62⅞, a net loss of 4 points. Metropolitan Street Railway showed some weakness, closing at 171¼, which is a net loss of 2 points, the sales being 104,900 shares. Electric stocks held their own throughout the week, General Electric closing at 291, a net gain of ¼ point. The highest point reached by this stock during the week was 295. Western Union remains unchanged at 91; Westinghouse common made a net gain of 1¾ points, closing at 177, and Westinghouse first preferred is unchanged at 180. Other closing quotations are: American District Telegraph, 34½, a net loss of 1½ points; American Telegraph & Cable, 90¾, a net gain of 2 points, and Manhattan Elevated, 134, a net gain of ⅛ point. Following are the closing quotations of Tuesday, Feb. 18:

NEW YORK.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
American Tel. & Cable...	91	91	General Electric.....	292	290
American Dist. Tel.....	34	30	General Carriage.....	1	⅞
Brooklyn Rapid Transit..	66⅝	62¾	Hudson River Tel.....	—	—
Ches. & Pot. Telephone.	—	—	Metropolitan Street Ry..	171⅜	171⅛
Commercial Cable.....	162	155	N. E. Elec. Veh. Tran...	—	—
Electric Boat.....	26	26½	N. Y. Elec. Veh. Tran....	14½	13½
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	—	1¾	Tel. & Tel. Co. America.	—	4½
Electric Vehicle.....	2½	2	Western Union Tel.....	91⅛	90⅞
Electric Vehicle pfd.....	4¾	4¼	West. E. & M. Co.....	176½	174
			West. E. & M. Co., pfd..	179	175

BOSTON.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
Am. Tel. & Tel.....	158	158	Mexican Telephone.....	2	.2
Cumberland Telephone...	—	—	New England Telephone.	140	*140½
Edison Elec. Illum.....	—	257	Westinghouse Elec.....	88	*90
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	90
General Electric pfd.....	—	292			

PHILADELPHIA.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
American Railways.....	—	—	Phila. Traction.....	99½	—
Electric Storage Battery.	62	—	Philadelphia Electric....	4½	—
Elec. Storage Batt'y pfd.	62	—	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	8	—	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Feb. 10.	Feb. 18.		Feb. 10.	Feb. 18.
Central Union Telephone.	—	—	National Carbon pfd....	83½	83
Chicago Edison.....	164	—	Northwest Elev. com....	38¼	—
Chicago City Ry.....	219	210	Union Traction.....	15	15⅝
Chicago Telep. Co.....	—	—	Union Traction pfd.....	49½	48½
National Carbon.....	20¼	20½			

*Asked.

EVERETT-MOORE AFFAIRS.—Creditors of the Everett-Moore syndicate, officials of the Federal Telephone Company and a subcommittee representing the bankers' committee in charge of the syndicate's affairs are considering a plan for refinancing the Federal Telephone Company. It is stated that if the plan is successful, it will not only obviate the necessity of selling or leasing any of the traction properties, but will place the syndicate on its feet to resume operations. The plan is to float a bond issue on all the properties of the Federal Company, the issue to be on the collateral trust plan under which the stocks and bonds of the subsidiary companies are to be deposited with some local trust company, and a bond to the amount of $5,000,000 to be issued against them. The bond would be divided into three issues, the first to cover a loan of $1,000,000 for development purposes, the second of $2,000,000 to go to the secured creditors who at present hold Federal securities on claims, and the third of $2,000,000 to go to the unsecured creditors. A considerable sum of money other than that required for completing several of the plants which has already been arranged for is required to place the system at its maximum earnings basis. For instance, the Cuyahoga Telephone Company, Cleveland, requires an outlay of about $125,000 for additional apparatus to place the exchange in first-class shape. The Columbus Citizens' Company has reached the limit of its capacity, and it will require $300,000 to make needed improvements. The bond issue would be secured by the treasury assets of the Federal Telephone Company to the amount of $1,200,000, but which have a face value of $5,000,000. The remainder would be made up of other securities of the subsidiary companies that at present are hypothecated.

LIGHTING DEAL IN SAN FRANCISCO.—An effort is being made to get the control of the San Francisco Gas & Electric Company as a preliminary to a combination of a half dozen concerns supplying light and power in that city. To accomplish this end an offer has been made of $60 a share for 66,000 out of 130,301 shares of capital stock, payable on or before Feb. 1, 1904. This offer holds good till April 1 next. Pending the taking up of the option, the shareholders will be paid $2 yearly on shares placed to fulfill this condition. Fifty thousand dollars has been deposited with the Bank of California for the first quarterly payment. The identity of those back of this deal is kept a profound secret. One report has it that the $30,000,000 Colgate syndicate is promoting the deal. Others say Claus Spreckels is the moving spirit. The most plausible theory is that Rudolph Spreckels, head of the San Francisco Gas & Electric Company, is the chief spirit in the plan. The report of the scheme sent Gas and Electric stock up. The seven gas and electric companies represent a capital of nearly $19,000,000, while the net return is only 3.44 per cent.

PHILADELPHIA KEYSTONE TELEPHONE.—President Robert H. Foederer, of the Keystone Telephone Company, says that the reports that the Keystone Telephone Company is not meeting with success, and that he or the company or both have lost a large sum of money in the enterprise are absolutely without foundation. The Keystone Telephone Company is steadily progressing with its plans. Telephones are being installed at the rate of 300 a week, and by May 1 it is expected to have 5000 in operation. The number of contracts signed with the company already aggregate 8200, that is to say, business aggregating about $500,000 a year, is already contracted for. Connections have been arranged for covering the territory between Philadelphia and St. Louis and other lines have been arranged for, which practically assure to the company all the long-distance connections necessary or desirable. Contrary to report the Keystone Telephone Company is not negotiating for the use in Philadelphia of the system of the Telephone Company of America.

BONDS FOR $150,000,000.—The board of directors of the Brooklyn Rapid Transit Company, at a meeting Feb. 10, unanimously decided to submit for the approval of the stockholders at a special meeting to be called for March 20, 1902, a mortgage to secure bonds to the amount of not exceeding $150,000,000. The proposed mortgage is to be called "general consolidated and collateral trust mortgage," and the bonds are to bear interest at the rate of not exceeding 4 per cent per annum. Out of the $150,000,000 of bonds authorized, provision is made for the practical retirement at maturity, or sooner, if advisable, of all the various issues of bonds of the companies of the Brooklyn Rapid Transit System, amounting in the aggregate to $61,065,000, including $7,000,000 of Brooklyn Rapid Transit bonds. The exact use of the large portion of bonds not accounted for above does not yet appear.

SYNDICATE BUYS CONNECTICUT TROLLEY.—The Meriden, Southington & Compounce Tramway Company will soon be turned over to the United Gas Improvement Company, of Philadelphia, thus adding about 30 miles of paying electric lines to the already important holdings of the Connecticut Railway & Lighting Company. The price paid for the road is not given, but it is large, as the Consolidated Road's intention to connect New Haven and Waterbury through Cheshire added greatly to the value of the property and gave the syndicate the desired entry to Waterbury from the east. The charter of the Southington Company permits extension to Waterbury, and in this way a through line will be established from Waterbury to New Haven, to Meriden and north to Springfield, Mass. Mr. A. M. Young has the matter in hand.

PITTSBURG TELEPHONES.—The report of President Wilson, of the Central District & Printing Telegraph Company, (Bell telephone), shows that the increase in capital stock from $7,500,000 to $10,000,000 is absolutely necessary to meet the extension of the business of the company. The number of miles of wire operated is now 96,145, an increase of 18,497, or nearly 20 per cent during 1901. The number of subscribers is now 40,136, an increase of 4625 since January, 1901. The board elected at the stockholders' meeting is as follows: D. Wilson, president; D. F. Henry, George I. Whitney, Charles E. Speer, J. G. Stevenson, Daniel H. Wallace, F. P. Fish, P. Jay French and Joseph P. Davis. One-half of the new stock is to be issued this year and half in 1903.

DIVIDEND.—The directors of the Kings County Electric Light & Power Company have declared the regular quarterly dividend of 1½ per cent, payable March 1, to stockholders of record Feb. 19. American Railways directors have declared the regular quarterly

dividend of 1¼ per cent, payable March 15. The net earnings for six months ending Dec. 31 were $159,190, an increase of $80,646, and surplus after dividends of $74,791.

ELECTRIC COMPANY OF AMERICA.—An advance statement of the Electric Company of America for the year ended Dec. 31, 1901, issued by President Snowden, says: "It has been thought advisable to submit at this time a brief statement as to the condition of the company in advance of the report to be submitted at the annual meeting of the stockholders. Briefly, the company owns and operates the following plants: Atlantic Electric Light & Power Company, Atlantic City, N. J.; Electric Light Company, of Atlantic City, Atlantic City, N. J.; Scranton Electric Light & Heat Company, Scranton, Pa.; Suburban Electric Light Company, Scranton, Pa.; Scranton Illuminating, Heat & Power Company, Scranton, Pa.; Columbus Colliery, Scranton, Pa.; Dunmore Electric Light, Heat & Power Company, Dunmore, Pa.; Wheeling Electrical Company, Wheeling, W. Va.; Bridgeport Electric Light & Power Company, Bridgeport, Ohio; Rockford Edison Company, Rockford, Ill.; Edison Electric Illuminating Company (controlling interest), Altoona, Pa.; Canton Light, Heat & Power Company, Canton, Ohio; Auburn Light, Heat & Power Company, Auburn, N. Y.; Conshohocken Gas Light Company, Conshohocken, Pa.; Conshohocken Electric Light & Power Company, Conshohocken, Pa., and the Atlantic City Gas & Water Company (large interest), Atlantic City, N. J. The net earnings from operating these companies for the year ending Dec. 31, 1901, will exceed $327,000, which, after deducting the interest on the bonds of the subsidiary companies, will leave a total of over $275,000 applicable to dividends, or more than 9 per cent on our paid in capital. In this statement two plants—Canton and Auburn—have been owned and operated for only five months of the year. It will be seen from the above that the dividend we are paying, 6 2-3 per cent on the paid-in capital ($7.50 per share), leaves a large surplus to profit and loss. We confidently expect our net earnings from operating the above-named plants will exceed $300,000 in the year 1902. This estimate, based upon the actual earnings for 1901, with Canton and Auburn on a full year's earnings, is very conservative; it does not take into consideration any increase in earnings, although the plants show an average net increase of 15 per cent in 1901 over the previous year. The company is without floating debt of any kind, with the exception of bills for current expenses, which are paid every month. It has no bonded indebtedness whatever, and has largely reduced that of its subsidiary companies. The books of the company show a very large surplus of undivided profits. All the plants have been equipped with modern appliances and are now in first-class condition.

GENERAL ELECTRIC FIGURES.—Boston is still a headquarters for General Electric gossip and the following is published in that city: Although but 10 days have elapsed since the close of the fiscal year of the General Electric Company, Jan. 31, the books of the company are so closely up to date that the result of the year's operations have been determined. In round figures the General Electric Company did business the past year aggregating $36,000,000, or at the rate of $3,000,000 per month. This compares with $27,969,541 the previous year, $26,323,636 for the year ended Jan. 31, 1900, and $11,-170,319 for the year ended Jan. 31, 1899. The directors may decide to charge off a portion of these net earnings to depreciation, but it is difficult to determine what to charge off, as the plant account now stands on the books for but $3,400,000, although the plants with their expensive machinery could probably not be duplicated for $15,000,000, while remaining assets of the company are now inventoried on a rock-bottom basis and are worth millions more than the price at which they are carried on the books. Net earnings of $12,000,000 on the outstanding $25,000,000 common stock (there remains but $500,000 debenture bonds and $10,000 preferred stock not converted into common stock) are equivalent to 48 per cent. It is the expectation of the management, having in view the fact that the output for 1902 is already largely contracted for, that it will transact a business of $3,500,000 per month during 1902, 33 1-3 per cent of which should be net. It is not unlikely that in view of the remarkable showing of earnings which the company will be able to present, covering the operations of the past year, that the question of capital readjustment will be taken up in the early spring, upon the return of President Coffin from abroad. After the restoration of the capital reduction of 1898 the capital stock of the General Electric Company will stand at $40,000,000, and net earnings of $12,000,000 would mean 30 per cent upon such a capitalization.

CONNELLSVILLE (PA.) TROLLEYS.—The Connellsville Suburban Street Railway Company has taken over the stock of all the other traction companies in Connellsville, and has issued $175,-000 of 30-year 5 per cent gold bonds in payment for the same.

TO LIST AMERICAN TELEPHONE BONDS.—Application has been made to the New York Stock Exchange to list for the American Telephone & Telegraph Company $13,000,000 additional 4 per cent collateral trust bonds.

INCREASE OF CAPITAL.—The Western Electric Company proposes to increase its capital stock from $8,000,000 to $15,000,000, and the number of directors from 9 to 11.

Commercial Intelligence.

THE WEEK IN TRADE.—Advices received by the mercantile agencies indicate hardening of prices, due to the expansion of sales on spring account, demand for manufactures and industrial operations generally. Especially good reports come from the West and Northwest, and the leading Eastern markets also showed a growth of sales for spring. The demand for and consumption of iron and steel are alike in advance of all past records. Scarcity of pig iron, steel billets and other crude materials is still a feature, and high premiums are being paid for prompt deliveries. It is stated that there never were so many orders on iron manufacturers' books for future delivery as now, and that the bar mills are sold ahead for five months. Re-orders of agricultural implement manufacturers are a feature. *Bradstreet* calls attention to the large and growing loss by fire as a serious menace and tax upon the community. General compilations show that the aggregate fire loss for the three prosperous years, 1899, 1900 and 1901, exceeds the loss from all business failures by $87,000,-000, or 25 per cent. The railway earnings are still in excess of a year ago, the aggregate for January being $60,370,661, a gain of 7.6 per cent over January last year. Far Western and Northwestern roads returned the heaviest percentage, 23.7 per cent and 18.6 per cent, respectively. Central West roads report a gain of 6 per cent, and those of the South, 5.2 per cent. The business failures for the week, as reported by *Bradstreet's*, numbered 265, as against 247 the week previous, and 226 the same week last year. The consumptive demand for copper seems to be indifferent, and it is weaker here and abroad. The market ruled dull in spite of the fact that business in all branches seems to be very brisk. Exports continue on a large scale. The closing quotations are 12¼@12⅜c. for Lake, 12@12¼c. for electrolytic, 11¾@12c. for cathodes, and 12⅛c. for casting stock.

PITTSBURG RAILWAY EQUIPMENT.—The Philadelphia Company, of Pittsburg, which controls all the street railways of Pittsburg and Allegheny City as well as the suburbs, gave out contracts on Feb. 14 for additional equipment to its lines as well as for improvements in the power generating plant which aggregate upwards of $2,000,000. A new central power station is to be built at Brunots Island in the Ohio River, about 3 miles below Pittsburg, where the company intends to generate all the power to be used on its network of street railways as well as in the various lighting plants controlled by it. Contracts were given to the Providence Engineering Company for six steam engines, aggregating 20,000 hp capacity. The boiler plant will be equipped with Babcock-Wilcox boilers. Contract was also let for 100 cars.

BOOK TYPEWRITERS FOR ABROAD.—The Elliott & Hatch Book Typewriter Company, of 256 Broadway, reports a number of orders recently received for foreign governments, etc. The Russian representative of the company, M. Sekerinsky, of St. Petersburg, has forwarded an order for 100 machines which are to be used in several of the government departments. M. Kurosawa, of Tokio, the agent in Japan, has requisitioned for 25 of the largest machines for the Department of Communication and Record Office of the Japanese Government. Substantial contracts have also been lately received from the London offices of the Elliott-Hatch people for book typewriters to be utilized in various municipal record and railroad offices throughout the United Kingdom, where it is said nearly 2000 of these machines are already in use.

TO EXHIBIT MACHINERY BY BIOGRAPH.—The General Electric Company has taken the largest area of space—3000 ft.—so far applied for by an individual firm at the exclusively American exposition, which is to be held at the London Crystal Palace from May to October, this year. The company will exhibit machinery in motion by means of the biograph, thus being able to illustrate the operation of the most intricate movements of machines free from noise.

ELECTRIC RAILWAY FOR ITALY.—A special cablegram from Rome, Italy, dated Feb. 15, states that the American Westinghouse Company has promoted a bill for the construction of an electric railway between Rome and Naples. It is added that the distance (118 miles) will be covered in 2¼ hours. The journey now occupies six hours.

ORDER FOR ELECTROLYTIC COPPER.—The *Detroit Journal* says that the American Copper Mining Company, of Detroit, has entered into a contract to deliver to the American Metal Company, Limited, of New York, 150 tons of electrolytic copper in ingots monthly, at a uniform cost of 11 cents per pound.

THE PITTSBURG CONDUIT COMPANY is reported to be contemplating the erection in East St. Louis of a plant that will employ 500 men to manufacture aluminum wire.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Feb. 12: Antwerp—16 pkgs. electrical material, $703; 1 pkg. electrical machinery, $862. Argentine Republic—141 pkgs. material, $1,162; 41 pkgs. machinery, $2,694. Brussels—1 pkg. material, $131. British West Indies—11 pkgs. material, $161. British East Indies—92 pkgs. machinery, $31,165; 166 pkgs. material, $5,133. Barcelona—33 pkgs. machinery, $1,348. British Australia—70 pkgs. wire, $1,614; 52 pkgs. machinery, $8,097. Brazil—201 pkgs. material, $4,879. Bristol—2 pkgs. machinery, $282. British Possessions in Africa—2 pkgs. material, $134; 35 pkgs. material, $2,041; 2 pkgs. cables, $800. Bath—1 pkgs. wire, $200. British Guiana—4 pkgs. material, $145. Cuba—15 pkgs. machinery, $4,870; 90 pkgs. material, $1,663; 172 pkgs. wire, $821; 1 pkg. manufactures of copper, $68. Corruna—16 pkgs. wire, $347. Carlisle—1 pkg. machinery, $45. Chili—23 pkgs. material, $1,299. Christiania—8 pkgs. wire, $207. Central America—66 pkgs. material, $844; 100 pkgs. wire, $225. Copenhagen—8 pkgs. material, $125. Dusseldorf—9 pkgs. machinery, $100. Danish West Indies—8 pkgs. material, $129; 2 pkgs. machinery, $43. Ecuador—1 pkg. material, $15. Glasgow—11 pkgs. machinery, $1,103; 35 pkgs. material, $395; 25 pkgs. cables, $7,010. Genoa—21 pkgs. material, $235; 10 pkgs. machinery, $9,000; 112,000 lbs. copper, $12,320. Hull—5 pkgs. wire, $195. Halifax (Eng.)—1 pkg. material, $50. Huddersfield—5 pkgs. material, $150. Havre—51 pkgs. material, $2,295; 4 pkgs. machinery, $170. Hamburg—13 pkgs. machinery, $1,195; 8 pkgs. material, $323. London—8 pkgs. manufactures of copper, $375; 37 pkgs. electric cables, $11,514; 164 pkgs. machinery, $7,142; 89 pkgs. material, $4,126. Liverpool—29 pkgs. machinery, $2,351; 126 pkgs. material, $5,002; 24 pkgs. copper material, $131,160; 4 pkgs. manufactures of copper, $225; 224 pkgs. copper wire, $4,622. Mexico—4 pkgs. manufactures of copper, $66; 126 pkgs. material, $2,727; 154 pkgs. machinery, $19,391; 319 pkgs. wire, $1,368. Manchester—1 pkg. material, $50; 12 pkgs. machinery, $3,250; 128 pkgs. machinery, $49,460. New Foundland—2 pkgs. material, $82. Newcastle—6 pkgs. machinery, $2,600. Nova Scotia—32 pkgs. material, $314. Preston—4 pkgs. material, $118. Peru—17 pkgs. material, $596. Reval—7 pkgs. material, $250. Rotherham—3 pkgs. material, $100. Santo Domingo—5 pkgs. material, $29; 1 pkg. manufactures of copper, $40. Southampton—6 pkgs. manufactures of copper, $40; 123 pkgs. machinery, $17,608; 10 pkgs. material, $300. Tasmania—1 pkg. wire, $18. U. S. Colombia—20 pkgs. material, $119. Vienna—1 pkg. material, $15; 5 pkgs. machinery, $200. Vladivostock—4 pkgs. material, $198.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, is actively engaged in preparing and installing a great number of railway and lighting batteries that are to be put into operation within the next few months. In addition to the three large batteries for the Twin City Rapid Transit Company, which were mentioned recently, the West Hampton Park Railway, at Richmond, Va., has contracted for a battery of 250 cells of 480 ampere-hours capacity; the St. Albans St. Railway Company is to be equipped with 216 cells; the Indianapolis & Eastern Traction Company, Indianapolis, has contracted for 230 cells for regulation and emergency work; the San Juan & Santa Clara Railroad Company, at San Jose, Calif., is having a battery of 264 cells installed for the purpose of regulating the fluctuation in their railway power station. This plant is operated by a Westinghouse gas engine and generator, and the battery is intended to furnish power during the period of light load when the generator will be shut down. The Trenton Street Railway Company, Trenton, N. J., is having installed 264 cells with a capacity of 200 amperes for regulation on their Princeton Division. The Chippewa Valley Electric Railroad Company is having installed at Eau Claire, Wis., a battery of 264 cells with a discharge rate for regulation of 200 amperes. The Virginia Electric Railway & Development Company has recently installed at Richmond, Va., a battery of 1440 ampere-hours capacity. The 280 cells comprising this battery are in containing tanks of sufficient size to allow of an increase of 25 per cent in capacity. The battery is to be divided—140 cells to operate on each side of a three-wire lighting system. The company has under construction a battery of 134 elements for the Washington Arcade office building in Detroit, Mich., to be used as a regulator to absorb the fluctuations caused by elevator service and to furnish power for night lighting. A battery is also being installed for the Pennsylvania Epileptic Hospital and Colony Farm, at Oakbourne, Pa., for lighting purposes. A battery of 160 ampere-hours is being placed on the private yacht "Helenita," owned by Mr. Frank J. Gould, and there are five yachts being built by Messrs. Tams, Lemoine & Crane, each of which is to be equipped with batteries of Chloride accumulators.

PELTON WHEEL CONTRACTS.—Among the orders which the Pelton Waterwheel Company is filling from its San Francisco works are: Wheels for driving four 500-kw units for the Pike's Peak Power Company, Victor, Colo.; a 1200-hp wheel plant for the Morning Mine, Mullan, Idaho; wheels, etc., for pumping station for the city of Seattle, Wash.; two 600-hp units for the Central California Electric Company, of Auburn, Calif.; one 500-hp unit for electric lighting plant of the Crystal Lake Gold Mining Company, Lundy, Calif.; three 300-hp units for electric transmission of the Hilo Electric Power & Refrigerator Company, Hilo, H. I.; one 300-hp wheel for a silk factory in Japan; one 200-hp air compressor wheel for a plant in British Columbia; three wheels, each direct connected to a 1000-kw generator for the Keswick Electric Power Company, Shasta County, Calif.; a 1000-hp wheel, connected to generator, Big Creek Power Company, Santa Cruz, Calif.; one additional 1000-hp unit for the British Columbia Electric Railway Company; a 1500-hp unit for the electric transmission plant of the Tuolumne County Power Company, Columbia, Calif.; wheels for driving a 1000-kw electric generator at the Utica Mine, Angels, Calif., this being the second unit installed; four units, each consisting of a waterwheel and a 550-hp generator, for the electric transmission plant of the Sierra Power Company, of Los Angeles, Calif. The already great foreign demand for this class of machinery has increased.

THE BROWN HOISTING MACHINERY COMPANY, of Cleveland, Ohio, have just been awarded a $500,000 contract for a complete modern iron ore handling equipment for the new blast furnace now being erected at Clairton in Western Pennsylvania by the St. Clair Furnace Company. The plant will consist of a car dumper, two bridges and 700 ft. each of iron ore and coke bins. It is to be ready in time for the operation of the blast furnaces next fall. The motive power will be electricity, very large electric motors being used, as in several of the other recent Brown plants of this character. Some of the Elwell-Parker motors in these equipments run as high as two and three hundred horse-power.

BIDS FOR POWER EQUIPMENT FOR MINNEAPOLIS.—The Twin City Rapid Transit officials at Minneapolis opened bids a few days ago for the entire electrical equipment for the new steam power plant. The plans and specifications call for two 1500-kw engine type generators, two 3500-kw engine type generators, 10 rotary converters and 216 static transformers and impulse wheels. Bids were received from four companies: The General Electric Company, the Bullock Company, of Cincinnati; the Stanley Manufacturing Company, of Pittsfield, Mass.; the Jones-Underfeed Stoker Company. The cost of the electrical equipment will be between $400,000 and $500,000.

TELEPHONY IN NATAL.—The corporation of Durban, Natal, S. A., has acquired the obsolete system of a local telephone company, with the object of installing an up-to-date system. It is understood that the new exchange is to have a capacity for at least 2000 subscribers, and that particular stress will be laid on securing apparatus that involves least cost in maintenance, in order to secure greatest economy in the long run. Mr. John Roberts, borough electrical engineer of Durban, has charge of the matter, we believe, and he would appear to be now investigating the subject. Catalogues, etc., should, therefore, be forwarded to him.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has just closed a contract with the Rensselaer Telephone Company, Troy, N. Y., for one of its "major" relay type switchboards of 3000 lines' capacity, with a present capacity of 1500 lines. Included in this contract is all necessary power apparatus, chief operator's desk, wire chief's deck, and a toll board of 100 lines' capacity, with present equipment of 40 lines. These people will not rely wholly upon the city current for their source of energy, but will install a gas engine as a reserve in case of any trouble with the local electric light company's service.

THE SOUTHERN PACIFIC RAILWAY COMPANY has decided to improve its facilities at various points on its system for the building and repairing of rolling stock, and to this end has placed with the American Bridge Company, of New York, a contract for boiler shop at East Portland, Oregon; boiler and machine shops at San Francisco, Calif.; boiler and machine shops at Los Angeles, Calif.; machine shop at El Paso, Texas; machine shop at Houston, Texas. These buildings are all about 120 ft. by 250 ft., equipped with traveling cranes.

THE CLEVELAND CRANE & CAR COMPANY, Cleveland, Ohio, manufacturer of electric cranes, has purchased a large building site at Wickliffe, Ohio, east of Cleveland, and is preparing plans for a large plant. The main shop will be 160 ft. by 125 ft., and there will be a separate power house, as it is the intention to install electrically-driven machinery.

THE BALL ENGINE COMPANY, Erie, Pa., is building for the Mt. Vernon shops, Baltimore, of the Pennsylvania Railroad, a 200-hp tandem compound engine arranged for direct connection to a Westinghouse alternator. The engine is provided with synchronizing devices, as it is to run in parallel with another engine.

ELECTRIC RAILWAY FOR SHANGHAI.—The council of Shanghai, China, has, as already noted, invited bids until March 7 for the construction of an electric railway system in that city. Similar improvements will probably be carried out in Hong Kong, Tien-Tsin, and other Chinese ports.

General News.

THE TELEPHONE.

HUNTSVILLE, ALA.—The American Telephone & Telegraph Company is making arrangements to have a long distance telephone line constructed between this city and Chattanooga.

YUMA, ARIZ.—The Colorado River Telephone Company, which was recently incorporated, will have Yuma as its principal place of business. The directors are A. Modesti, R. S. Patterson, J. Gandolfo, F. G. Blaisdall, E. Sanguinetti, L. F. Bradshaw and R. P. H. Laney. The capital stock is $10,000.

ALMA, ARK.—The Alma Telephone Company, capital stock $2,500, has been incorporated. Col. Jacob Yoes is president.

SAN FRANCISCO, CALIF.—A telephone franchise has been granted to C. L. Hafey by the Commissioners of Dona Ana County, New Mexico. The proposed line will extend from Mesilla to Las Cruces.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has on hand estimates for extensions of its lines and other improvements, amounting to $2,141,035, for the present year. The first shipment of Pupin coils to the Coast is expected in April, when several lines will be equipped with light copper wires and the new coils. It is probable that the new line in course of construction across the Cascades Mountains from Seattle to Spokane, Wash., will be the first one on the Coast to use the new system. The distance is over 300 miles. It may also be applied to a line from Portland, Oregon, to Los Angeles, Calif., where it would greatly increase the commercial efficiency of the line. It is probable that the company's California and Arizona long-distance systems will be connected during the year. A fine three-story telephone exchange building is being constructed in Los Angeles, and the underground system there, and in other cities, is being extended. New exchanges are being built in Walla Walla and Everett, Wash. A lot 100x100 has been purchased on the East Side in Portland, Ore., where an exchange will be erected for the districts east of the Willamette River. The company will float additional bonds, amounting to $1,000,000, April 1. There are more than 30,000 telephones in use in San Francisco on this system.

GREELEY, COLO.—The Morgan County Telephone Company has been incorporated, with a capital stock of $35,000. Incorporators: D. E. Gray, Geo. Settle and E. J. McMurray, all of Greeley.

BEASON, ILL.—Residents of Beason have organized a mutual telephone company.

GIBSON CITY, ILL.—The Gibson Telephone Company has increased its capital stock from $12,000 to $15,000.

CARTHAGE, ILL.—The Hancock County Telephone Company has increased its capital stock from $2,500 to $10,000.

CHAMPAIGN, ILL.—The Home Telephone Company at Champaign is planning to expend $6,000 in improving the service.

COLFAX, ILL.—The Village Council of Colfax granted a franchise for a local telephone exchange to J. Fielding and William Gaddis.

WAPELLA, ILL.—The Long Point Mutual Telephone Company has been incorporated by C. S. Swearingen, J. M. Rollofson and J. S. Williams.

CHICAGO, ILL.—The Kempton Telephone Company, of Kempton, Ill., has been incorporated by Carl Shulz, John Bergan and J. T. Corkill; capital, $1,200.

NEPONSET, ILL.—The Osceola and Neponset Telephone Company, capital stock $10,000, has been incorporated by F. W. Bates, Charles Lewis and E. B. Hill.

FOREST CITY, ILL.—The Forest City Telephone Company, with a capital of $2,500, has been incorporated by E. J. Bowser, E. J. White and John Pemberton.

HOOPPOLE, ILL.—Hooppole & Annawan Telephone Company, capital stock $1,875, has been incorporated by F. A. Lohman, C. W. Berge and George Mathais.

CHICAGO, ILL.—A committee of the Chicago City Council is investigating the financial affairs of the Chicago Telephone Company to aid in determining the proper rates to be charged for telephone service.

BLANDINSVILLE, ILL.—There is talk of the farmers organizing a new telephone line from the east side of Hire Township extending to Blandinsville, the company to be called to Hire Township Telephone Company.

CHICAGO, ILL.—The Illinois Manufacturers' Association has started suits to recover $2,500,000 paid by subscribers for metallic circuit telephones to the Chicago Telephone Company the past eight years in excess of what Judge Tuley recently decided was the legal rate permitted by the terms of the franchise.

CHICAGO, ILL.—It is stated that the Illinois Telephone & Telegraph Company has drawn plans and made contracts for installing an exchange of 25,000 telephones in the business district by July 1. It has completed more than half of its wire tunnels under the downtown streets. Its backers, organized as the Automatic Electric Company, have recently bought the patents on the Strowger automatic switchboard, which will be used.

CHICAGO, ILL.—The Chicago Telephone Company has appealed the case to the Supreme Court in which Judge Tuley decided that $125 is the maximum rate the company can charge for yearly rental of a business telephone. On metallic circuit telephones, the rental has been $175 since 1893. The company has now asked subscribers paying the $175 rate to pay $125 and furnish bond that they will pay the other $50 if the decision is favorable to the company, or if the $175 is paid the company will pay $50 per year back without interest if the decision is against the higher rate.

CENTERVILLE, IND.—The Centerville Telephone Company, composed of business men and farmers, has been organized here to build lines and operate in the surrounding country, with an exchange at Centerville.

WHITESTOWN, IND.—The Whitestown Telephone Company, $5,600 capital stock, has been incorporated. Directors: Benj. F. Hawkins, Preston Smith, H. John Burnes, Francis A. Stark, Alva E. Hine, Roy Smith, Jos. P. Van Camp and Robert G. Ferguson.

INDIANAPOLIS, IND.—The People's Co-operative Telephone Company filed articles of incorporation, with a capital stock of $6,000. The directors are M. L. Clouser, John H. Hutchinson, Lewis Kirk, George W. Deek and Marshall Hampton. The company will operate in Montgomery and Boone counties with headquarters at Bowers.

PLAINFIELD, IND.—The Plainfield Telephone Company, recently organized, has had a rapid growth and is prosperous. In addition to the 360 telephones now in use the enterprising managers have line connection with Danville, Avon, Cariby, Jopa, Friendswood, Bridgeport and Indianapolis. The line to Bridgeport was completed recently at which point 14 telephones were added.

FONDA, IA.—The Northern Telephone Company has increased its capital stock from $20,000 to $50,000.

HANCOCK, IA.—The Hancock Telephone Company, capital stock $10,000, has been incorporated by J. T. Armstrong, Chas. Warner and others.

ARMSTRONG, IA.—There is a movement on foot to build a number of rural telephone lines in the spring to connect with the local exchange here.

SHANNON CITY, IA.—Articles of incorporation were filed by the officers of the Shannon City Telephone Company. P. W. Miller is president and Clarence McConnell, secretary.

SHADYGROVE, IA.—A farmers' telephone line is being talked of between this place and Brandon. It is also reported that the Wettstein line will be extended from La Porte to this place in the near future.

SPRINGVILLE, IA.—The Springville Telephone Company, which was recently organized, contemplates extending its lines to adjacent towns. It now has about seventy miles of line in operation and 180 subscribers.

DES MOINES, IA.—Mr. Sweeley has presented a bill in the House providing for municipal ownership of telephone exchanges and lines, the regulation of rates and to compel the systems to connect with one another for toll line business.

MANCHESTER, IA.—The Delaware County Telephone Company, of Manchester, capital stock $10,000, has been incorporated by F. L. Durey, Burton Clark, W. D. Hoyt, G. W. Miller, G. S. Amsden, Charles A. Peterson and W. N. Wolcott.

WINTERSET, IA.—The farmers between Winterset and Pitzer are constructing a rural telephone line between these points. As soon as the line is completed to Winterset a company is to be formed and a franchise asked for to operate the line in the city.

TULSA, I. T.—The Indianola Telephone Company, of Tusla, will construct a line from Claremore to Sapulpa, a distance of forty-five miles.

BELLE PLAINE, KAN.—The Valley Telephone & Electrical Company has been incorporated; capital, $10,000.

FAIRVIEW, KAN.—The Fairview Telephone Company has increased its capital stock from $5,000 to $10,000.

WICHITA, KAN.—The Kansas Long Distance Telephone & Telegraph Company has been incorporated. Capital stock, $500,000. Fred. and M. C. DeLand, of Pittsburg, Pa.; L. A. Stebbins, C. J. Evans and H. A. Branaman, of Topeka, Kan., are the incorporators.

LUDLOW, KY.—The Kentucky Telephone Company will extend its lines into Boone County.

EMINENCE, KY.—The city of Eminence sold a telephone franchise to R. M. Barker, of Carrollton for $50 for twenty years. It is said that Barker will establish a service and connect with the Home Telephone Company, of Louisville, Ky.

MOUNT VERNON, KY.—While Judge Durham, magistrate in the Wildie district, was in town on business he was called up over the telephone by Constable Harry Jones, who said he had in charge Dan Dickerson, charged with breach of the peace. Dickerson asked an immediate trial, and it was agreed to conduct the trial over the telephone wires. Half an hour's use of the wire by Judge Durham and County Attorney Bethurum at this end and the constable and defendant at the other concluded the trial. The defendant was fined, and the fine with costs, amounting to $12, was promptly paid.

PORTLAND, ME.—The New Portland & Kingfield Telephone Company, of New Portland, Me., has been incorporated with a capital stock of $1,000 by B. F. Bartlett and E. B. Quint, of North New Portland.

NORTH ADAMS, MASS.—Local men are said to be interested in the proposition to form an independent telephone company whose lines shall cover Northern and Central Berkshire.

BOSTON, MASS.—The American Telephone & Telegraph Company reports its output of instruments for the month ended Jan. 20, with comparisons, as follows: Gross output—1902, 87,412; 1901, 66,048; increase, 21,364. Returned—1902, 34,796; 1901, 25,766; increase, 9,030. Net output—1902, 52,616; 1901, 40,282; increase, 12,334. Total outstanding Jan. 20—1902, 2,578,626; 1901, 2,081,208; increase, 497,418.

JACKSON, MICH.—The Farmers' Telephone Company, capital stock $10,000, has been incorporated.

LESLIE, MICH.—The Bunker Hill Telephone Exchange has been incorporated, with a capital stock of $500.

LITCHFIELD, MICH.—The Litchfield Telephone Exchange has been incorporated, with a capital stock of $10,000.

DETROIT, MICH.—The Co-operative Telephone Company, of Detroit, will apply to the Common Council for an ordinance to authorize it to construct a quasi-municipal or co-operative telephone system in the city.

PONTIAC, MICH.—D. P. Yerkes has accepted a telephone franchise granted him by the Common Council of Milford village and proposes to begin the erection of an exchange and telephone lines as soon as weather permits. The lines will probably connect with the Oakland lines running out of this city.

ST. PAUL, MINN.—The Twin City Telephone Company has increased its capital stock from $1,000,000 to $1,500,000.

ELLSWORTH, MINN.—The Ellsworth Automatic Telephone Company has been incorporated with a capital stock of $10,000.

KANSAS CITY, MO.—At the annual meeting of the stockholders of the Missouri and Kansas Telephone Company, the capital stock was increased from $2,500,000 to $5,000,000.

BATTLE CREEK, NEB.—The Battle Creek Telephone Company has been incorporated by F. C. Meinecke and others; capital stock $5,000.

ODELL, NEB.—The Deller Independent Telephone Company has secured the required number of subscribers to enable it to put in an exchange and extend its lines to Odell.

OGALLALA, NEB.—Business men here have effected a temporary organization for the purpose of building a telephone line to extend from Keystone and Lincoln to Ogallala.

DAWSON, NEB.—The Dawson-Nemaha Telephone Company, capital stock $2,500, has been incorporated. Directors: O. C. Ayres, F. L. Blakeny, Rice Page, R. E. Fenton and J. G. McGinnis.

HUMPHREY, NEB.—The Humphrey Electric Light & Telephone Company has been organized, with a capital stock of $15,000, to conduct an electric light and telephone business in Humphrey. The promoters are H. J. Bruenig, J. E. Hugg and P. E. McKillip.

WAHOO, NEB.—A franchise for an independent telephone company has been granted to H. H. Hurst and M. White, of Iowa, and Mayor T. C. Parmelee, of Plattsmouth, Neb., who are the principal promoters. The exchange and all lines will be completed by May 1.

OMAHA, NEB.—The Plattsmouth Long Distance Telephone Company has just been granted franchises in Aurora, York, and Norfolk, Neb., to which points it will extend its lines. This will require several hundred miles of line. This company already has exchanges in over a hundred towns and cities.

HUMBOLDT, NEB.—A new company has been organized, with a capital stock of $2,500 to build rural telephone lines from Dawson to Middleburg. Following are the directors: J. G. McGinnis, Oliver Ayers, Rice Page, Frank Blakeney, and R. E. Fenton. Many farmers along the line have taken stock.

HOOPER, NEB.—The stockholders of the Hooper Telephone Company at a special meeting decided to consolidate with the Farmers' Telephone Company now operating forty miles of line in the western part of the county. The consolidated company will cover all of Dodge County, establish a local exchange in every town in the county and give service for 80 cents per month.

REIDSVILLE, N. C.—The Reidsville Telephone & Telegraph Company proposes to install exchanges in a number of near-by towns, and also to build several long-distance lines. Mr. R. J. Oliver is the manager. The exchange has a switchboard capacity of 144 drops and 140 subscribers. It is operating 110 miles of toll lines.

MEDFORD, N. J.—The Interstate Telephone Company is building a new line from here to Marlton.

AUBURN, N. Y.—The Auburn Telephone Company has made application to the Board of Trustees of the village of Skaneatales for a telephone franchise.

NEW YORK, N. Y.—Mr. Stokes, proprietor of the new Ansonia Hotel, at Broadway and Seventy-third Street, New York, has just closed a contract with the New York Telephone Company for a private branch exchange in that hotel with 360 stations. This will be the largest private branch exchange in New York City.

POLK, OHIO.—Howard Shwartz is promoting a new telephone company with a view to building up a farmers' system.

WASHINGTON C. H., OHIO.—The Washington Home Telephone Company has been incorporated with $100,000 capital stock.

ATHENS, OHIO.—The Hickory Grove Telephone Company, of Athens County, has been incorporated, with $1,375 capital stock, by T. C. Robinson, P. W. McLenahan, C. S. Griffin, L. J. Oxley. J. C. McLain, D. W. Kenney and W. A. Barnhill. They will build a farmers' system.

YOUNGSTOWN, OHIO.—The Beaver Telephone Company, which is preparing to erect an exchange at North Lima, has been incorporated, with $10,000 capital stock, by Allen Rickert, W. H. Ruhlman, Rudolph Metzler, S. M. Cupp and W. E. Metzler. Over 200 farmers in Beaver Township have subscribed for the service. Bids for long-distance service have been asked for from both the Bell company and the United States Telephone Company.

CLEVELAND, OHIO.—Officers of the United States Telephone Company and the Cuyahoga Telephone Company were elected Feb. 3. The bankers' committee in charge of the Everett-Moore affairs and of several of the leading creditors were given representation on the boards of directors. The officers of the United States Telephone Company are H. A. Everett, president; E. W. Moore, vice-president; J. B. Hoge, secretary; R. W. Judd, treasurer. Directors: J. B. Hanna, B. Mahler, H. A. Everett, J. B. Hoge, E. W. Moore, K. G. Roebling, J. W. Marsh, C. W. Wason and Maxime Reber. Cuyahoga Telephone Company: H. A. Everett, president; E. W. Moore, vice-president; J. B. Hoge, secretary; R. H. Judd, treasurer; directors, W. H. Lamprecht, H. A. Everett, J. W. Marsh, R. A. Harmon, B. Mahler, E. W. Moore, F. T. Pomeroy, K. G. Roebling, F. M. Stearns, H. R. Newcomb and C. W. Wason.

OKLAHOMA CITY, OKLA.—A company has been formed here for the purpose of selling, leasing and operating telephone exchanges in Texas, Indian Territory and Oklahoma. It will be known as the Automatic Telephone & Supply Company. The first towns to be equipped are Afton, I. T.; Fairland, I. T.; Tecumseh, Wakita and Billings, Okla.

WORCESTER, PA.—The Montgomery Telephone Company has been organized at Worcester, with a capital stock of $5,000. It is to be a farmers' telephone line.

PHILADELPHIA, PA.—The crossing of two wires in the main office of the Bell Telephone Company recently rendered useless 4600 telephones in the business section of the city and practically paralyzed the service for a day. This is the first time such an accident has happened in this city.

ELKTON, S. D.—The farmers living in the vicinity of Elkton are negotiating for the construction of a telephone line.

MENNO, S. D.—The Town Council has granted to the South Dakota Telephone Company, of Mason City, Ia., a franchise for a local telephone system.

SIOUX FALLS, S. D.—A company has been organized by farmers living in Hutchinson County for the construction of a telephone line connecting their homes with the systems of the towns in their localities.

SIOUX FALLS, S. D.—Farmers in the vicinity of Forestburg have decided to construct a telephone line from that place to Huron. An organization having this purpose in view was perfected, with George Alley as president and George Bonney as secretary.

LYNNVILLE, TENN.—The American Telephone Company is building a line from Nashville to Athens, Ala.

FORT WORTH, TEX.—The Southwestern Telegraph & Telephone Company is arranging to build telephone lines twelve miles into the country from Fort Worth for the accommodation of stock men.

NORFOLK, VA.—The Smithfield Telephone Company and the Isle of Wight Telephone Company have consolidated and merged in the Home Telephone Company. Of the consolidated company, J. W. Holloway is president; B. P. Gray, manager, and A. S. Barrett, secretary and treasurer. These, with Messrs. P. D. Gwaltney, P. D. Gwaltney, Jr., Z. W. Joyner and F. R. Berryman are directors.

MOUNT HOPE, WIS.—The People's Telephone Company has increased its capital stock from $4,200 to $6,000.

RACINE, WIS.—The Bristol Telephone Company has applied to the City Council of Kenosha, Wis., for the right to build its line from Pleasant Prairie into the city.

SOUTH MILWAUKEE, WIS.—The Wisconsin Telephone Company is installing an exchange in this city. There will be about forty telephones and the rate will be $1 per month, with extra charges for long-distance calls.

FOND DU LAC, WIS.—The Eagle Point Telephone Company has decided to extend its line to many principal points in the county and connect with the Chippewa County Telephone Company.

EAST TROY, WIS.—The Wisconsin Telephone Company has completed installing a new switchboard in the central office. The East Troy Telephone exchange, which is operated in connection with the Wisconsin Telephone Company has about 125 telephones.

MILWAUKEE, WIS.—The fourth annual meeting of the Wisconsin Independent Telephone Company will be held in this city on Feb. 19 and 20. The question of establishing an independent exchange in this city will be discussed. An alliance with the Rapid Transit Company of Minneapolis will also be considered and acted upon. The Rapid Transit people are desirous of building a long-distance copper metallic line into the State. They have already built a toll line from Minneapolis to Superior and Duluth and have let the contract for a toll system between Eau Claire and Minneapolis, and La Crosse and Minneapolis by way of Winona.

ELECTRIC LIGHT AND POWER.

DENVER, COLO.—The Colorado Coal Company will install electric machinery in its Tyron mine.

SAN FRANCISCO, CALIF.—The Ontario Power Company's stockholders have authorized a bonded indebtedness to the amount of $400,000, for carrying out the plans of their enterprise in California.

SAN FRANCISCO, CALIF.—The City Trustees of Healdsburg, Calif., recently adopted resolutions to the effect that it would be necessary to increase the capacity of the municipal electric lighting plant in the near future.

SAN FRANCISCO, CALIF.—The Electrical Construction Company, of San Francisco, is engineering the construction of an electric light and power plant for the proprietor of the hotel at Camp Taylor, Calif. It will be operated by a water wheel, direct connected to an alternating generator of large capacity. The current will be used to supply lights and also to operate the Taylor Paper Mills.

SAN FRANCISCO, CALIF.—The Standard Electric Company recently completed its main electric transmission line, 145 miles in length, from Amador County to San Francisco, after a vexatious delay in procuring the last right of way. A gap of six poles existed at the Dunphy ranch, near Milbrae, and a legal decision prevented the payment of what the company considered an excessive price for the privilege.

SAN FRANCISCO, CALIF.—The Central Light & Power Company, San Francisco, recently submitted a statement for 1901, showing that its revenue was $128,485.69, expenditures $81,688.07, cost of plant $238,600, floating debt $10,000. The company's electric light and power plant has a capacity of about 2000 horse-power. Material has been purchased for extensions of the underground mains and the plant will be considerably improved.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, San Francisco, reported its revenue for 1901 as $119,958.85. Expenditures, $111,624.32; original cost of plant, $421,018.51; capital stock, $500,000, of which $410,000 has been issued; floating debt, $35,286.53. The company's present plant has a capacity of 3000 horse-power, and plans have been prepared for a large additional generating station at a new site near the water front.

SAN FRANCISCO, CALIF.—The San Francisco Gas & Electric Company recently submitted its annual statement to the Board of Supervisors. The revenue from electricity was $643,063.75; cost of producing electricity, $573,389. The profits were $367,439.69, of which $227,042.70 was paid out as dividends, leaving the surplus $140,359.99. The company has received a 1000-kw General Electric generator, which will be direct connected to an engine constructed by

the Union Iron Works. It is a direct current machine. A 600-kw, 3-phase alternator and a 150-kw motor generator, both of General Electric manufacture, were installed in 1901.

SAN FRANCISCO, CALIF.—A new generator, having a capacity of 1000 horse-power, has been placed in operation at the Stanislaus Milling & Power Company's water power plant near Knight's Ferry, Calif. It will be used to supply current to operate the 40-stamp mill at the Alta Mine in Calaveras County, the distance of transmission being seven miles. The towns of Knight's Ferry and Oakdale have been lighted from this plant, in which Messrs. J. W. and C. T. Tullock are interested. It is their intention to extend their power line to Modesto, on the completion of the Modesto Irrigation District canal. At present, Modesto's streets are lighted by a municipal electric plant, but there is a demand for current for commercial lighting.

MOLINE, ILL.—Deere & Company, manufacturers of plows, will install a new power plant, using two 500-horse-power vertical engines with direct-connected generators.

NASHVILLE, ILL.—The Nashville electric light plant, owned by the Mineral Springs Light & Power Company was sold Feb. 1 to C. M. Forman, of East St. Louis, for St. Louis capitalists.

LEWISTON, IDAHO.—The Lewiston electric light plant has been sold to the Lewiston Water & Power Company. The new company's plans contemplate the erection of a large power plant at the mouth of the Grand Ronde River in Oregon to supply electric power to factories in Lewiston. The purchasers include Chas. Francis Adams and other Eastern capitalists.

BALTIMORE, MD.—The Morgantown Electric Light & Power Company has secured a franchise after a long struggle. The franchise carries the privilege of constructing street car lines.

COLDWATER, MICH.—Ex-Mayor A. A. Sherman was awarded the contract for the enlargement of the city water works and electric plant. His bid was $1,029. Coldwater is going to supply its citizens with light and has new and larger dynamos to take the place of the smaller ones which are nearly worn out.

MARQUETTE, MICH.—The Peninsula Electric Light & Power Company, of Marquette, has contracted with the Nordberg Engine Manufacturing Company for a 1500-hp cross-compound Corliss engine, and with the General Electric Company for a generator. The company has spent $100,000 in the last two years extending and rebuilding its lines throughout this county, and its capacity when the new machinery is installed will be 40,000 16-candle lights.

BUTTE, MONT.—This city will soon be supplied with electric power from a second electric transmission plant. The Madison River transmission system is nearing completion, and will have a good deal of power to sell. Current will be transmitted over an aluminum wire at an electro-motive force of 80,000 volts. The Butte Light & Power Company now supplies the city with electricity at 40,000 volts.

HUMPHREY, NEB.—The Humphrey Electric Light & Telephone Company has been incorporated, with a capital stock of $15,000, to conduct an electric light business here.

GARDNERVILLE, NEV.—An electric power plant is projected for the purpose of transmitting current to Gardnerville. It is the intention to locate the power-house on the main fork of the Carson River. Mr. George Lamy, of Gardnerville, is one of those interested in the proposition.

GRANVILLE, N. Y.—The Granville Light & Power Company has been incorporated, with a capital stock of $31,000.

PATCHOGUE, N. Y.—The Patchogue Electric Light Company has decided to extend its lines into Blue Point and is now making contracts there for wiring private houses.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company of Binghamton; capital, $500,000, has been incorporated to furnish electricity in Binghamton, Lestershire, Port Dickinson, Union, and other places in Broome County. Directors: Frank Cunningham, T. M. R. Meikleham, and Thomas J. Waters, of New York City; William B. Dinsmore, of Tuxedo Park, George W. Dunn, Clarence F. Hotchkiss, F. W. Jenkins, and George F. Johnson, of Binghamton, and Chauncey Eldredge, of Boston, Mass.

BAKER CITY, ORE.—The city authorities have granted A. B. Frame an electric lighting franchise.

EL RENO, OKLA.—The El Reno Light & Power Company is in the market for entire equipment for its new electric light plant. It recently purchased the plant of the El Reno Electric Light & Telephone Company, which will be replaced by one of increased capacity. The officers are Henry Lassen, president; John A. Masters, secretary and manager, and C. M. Jackman, treasurer.

BRADFORD, PA.—E. R. Caldwell & Company will extend their plant. There will be installed in the new building a 20-ton electric crane.

CHAMBERSBURG, PA.—Mr. F. S. Knight, superintendent of the city plant, issues a statement to the public as to its finances. He shows a total cost of operation of $14,902.28, and receipts of $20,624.97. They have expended for betterments and improvements $10,758.98, which added to bond issues makes a total cost of $55,758.98. Mr. Knight figures out a balance of $1,997.68, after allowances for the free lighting and the regular lighting.

SEWANEE, TENN.—A plan has been drawn for an electric light plant at this place.

HOUSTON, TEX.—The Leesville Light & Water Works Company has increased its capital stock from $20,000 to $40,000.

SALT LAKE CITY, UTAH.—The Salt Lake Supply Company was awarded the contract for the electric light plant and the wiring for the State prison of Utah.

SALT LAKE CITY, UTAH.—The Red Boy Mining Company, of Baker City, Ore., may develop the Olive Lake water right for the operation of the mine and mill. There is enough waterfall for 4500 horse-power. All the mine's machinery, including the hoist, will be operated by electric power. Power also will be furnished Cracker Creek and Cable Cove. The Sumpter and Bourne, Ore., electric road will be operated by power from this source.

SEATTLE, WASH.—The City Council of Seattle, Wash., recently received a detailed report from the Board of Public Works on the estimated cost of a proposed municipal electric light and power system. Three different sites for the plant have been considered in making the estimates.

PLAINFIELD, WIS.—An electric light plant will be built in the large grist mill of Stark & Skeel. It will furnish electricity for lighting the city.

THE ELECTRIC RAILWAY.

PRATT CITY, ALA.—The Steel City Railway is surveying for an electric line to be built from Ensley to Pratt City and adjacent mining towns west.

BIRMINGHAM, ALA.—At the annual meeting of the Birmingham Railway, Light & Power Company, Mr. S. H. March, representing Ladenburg, Thalmann & Company, and Mr. Davis, the engineer and general manager of the company, were elected to the board. Mr. Robert Jemison was elected president; Mr. A. Walker, vice-president; Mr. George H. Davis, vice-president and general manager, and Mr. J. P. Ross, secretary.

TUCSON, ARIZ.—The street car system of Tucson will be changed over to electric power, and the local electric light and gas company will rebuild and enlarge its present plant.

SAN FRANCISCO, CALIF.—The North Shore Railway Company, the successor to the North Pacific Coast Railway Company, has issued a call for a stockholders' meeting for April 5 at the San Francisco offices of the company. It is the purpose of the company to create at that time a bonded indebtedness of $6,000,000. Each of the 6000 bonds will have a par value of $1,000, and will be payable in forty years, with interest at the rate of 5 per cent a year. The road, which extends from Cazadero to Sausalito, will be improved and rebuilt during the next eighteen months at an expense of more than $1,000,000. A tunnel 4000 feet in length will cut down some of the heavy grades and do away with seven trestles. The southern end of the road from Mill Valley to San Rafael and Sausalito will be changed over to an electric road and operated and equipped in the most modern style. An order has been placed in the East for twenty-one vestibuled trolley cars which will be operated in trains of four or more, as desired. The electric power will be supplied from the lines of the Bay Counties Power Company. Under the supervision of J. A. Fillmore, the new general manager, who was for thirty years with the Southern Pacific Railroad, the present narrow-gauge road will soon be transformed into a model transportation line. There will be a high speed ferryboat, with twin screws at each end, to give quick connection between Sausalito and San Francisco.

ATLANTA, GA.—Mayor Mims has approved an ordinance granting the consolidation of the Atlanta Railway Power Company, the Atlanta Rapid Transit Company, the Georgia Electric Light Company and the Atlanta Steam Heating Company. The several companies will be taken over by the Georgia Railway & Electric Company, which applied for incorporation in December, 1901. The authorized capital stock of the company is $3,000,000.

ELWOOD, IND.—A company is being organized by local capitalists to build an electric railway from this place to Fortville.

JEFFERSONVILLE, IND.—Capt. E. J. Howard is considering the advisability of substituting automobiles for street cars in this city.

LAFAYETTE, IND.—The Standard Construction Company has been incorporated with a capital stock of $100,000, to build electric railways, etc. The directors are Addison Bybee, Allan R. Jewett, Nicholas W. Box, Hiram Kerlin, Arthur A. McKain, Charles A. Meeker, and Jacob F. Marks. The company contemplates the building of a line between this city and the Shawnee Mound country.

INDIANAPOLIS, IND.—Incorporation papers have been filed here by the Smith Construction Company, organized to build the Indianapolis & Western Traction Company. The capital stock is $25,000. The directors are Arthur B. Hogue, Amory T. Irwin, and Edward G. Hendrickson. The capital stock of the Indianapolis & Western Traction Company has been increased from $100,000 to $500,000.

MENOMINEE, MICH.—The Consolidation of the Menominee Electric Light, Railway & Power Company and the Marinette Gas, Electric Light & Street Railway Company has been effected.

GRAND RAPIDS, MICH.—The Grand Rapids Railway Company has elected officers as follows: President, C. M. Clark, of Philadelphia; first vice-president, Lester J. Rindge; second vice-president and general manager, G. Stewart Johnson; secretary and treasurer, Benjamin S. Hanchett, Jr.

GRAND RAPIDS, MICH.—The first official trip over the new Grand Rapids, Grand Haven and Muskegon Interurban Railway was made a few days ago from Grand Rapids to Muskegon. A distance of 34 miles was covered in 61 minutes. This road is operated on the third-rail system, the working voltage being 600. Current is generated at 23,000 volts and transmitted to sub-stations, where it is stepped-down.

FISHKILL, N. Y.—The Beacon Mountain Railway Company, with a capital stock of $150,000, has been incorporated.

ALBANY, N. Y.—The Buffalo, Springville & Cattaragus Railway Company has been incorporated. The capital is $1,000,000, and the road is to be operated by some power other than steam.

ALBANY, N. Y.—The Lake Erie Traction Company, of Westfield, has been incorporated, with a capital stock of $101,000. Among the directors are T. B. Hall, of Camden; M. E. White, of Norristown, Pa., and Wm. L. Minton, of Westfield.

ALBANY, N. Y.—Certificates of merger of the Elmwood Avenue & Tonawanda Electric Railway Company into the Buffalo & Lockport Railway, the Niagara Falls Whirlpool & Northern Railway into the Niagara Falls & Suspension Bridge Railway Company, and the Buffalo, Bellevue & Lancaster Railway Company and the Buffalo Traction Company into the Buffalo Railway Company, have been filed with the Secretary of State. W. C. Ely is president of the various companies and D. Rankine secretary.

FINDLAY, OHIO.—A company said to be composed of New York people is securing right of way for a new line to extend from Findlay to Defiance by way of Leipsic and McComb.

UPPER SANDUSKY, OHIO.—The Bucyrus, Upper Sandusky & Lima Electric Railway has been organized by the election of George D. Whipple, of Cuba, N. Y., president. The company was recently incorporated.

CLEVELAND, OHIO.—The Ohio Brass Company, of Mansfield, Ohio, has filed a lien against all the property of the Lake Shore Electric Railway Company for material furnished the company, amounting to $8,869.88.

CINCINNATI, OHIO.—A construction company has been formed to build the Fort Wayne, Dayton & Cincinnati Traction Company. The road will be 300 miles long, double tracked throughout, and will be operated on the third rail system.

CINCINNATI, OHIO.—The stockholders of the Southern Ohio Traction Company have ratified the purchase of the Miamisburg & Germantown Traction Company for $100,000 and for the Hamilton & Lindenwald Traction Company for $250,000.

LANCASTER, OHIO.—The Lancaster Traction Company held its annual meeting a few days ago. The officers are: H. B. Peters, president; A. Bauman, vice-president; E. K. Stewart, secretary-treasurer. The company is building a new power station.

MARION, OHIO.—Franchises through town have been granted to the Columbus, Marion, Tiffin & Toledo Railway and the Findlay & Marion Electric Railway. The first mentioned company was given permission to build a double track through the town.

TOLEDO, OHIO.—Stockholders of the Toledo & Bryan Air Line Railway Company have agreed to the consolidation of the property with the Ohio & Indiana Traction Company of Fort Wayne. The new corporation will be known as the Ohio & Indiana Air Line Railway Company.

COLUMBUS, OHIO.—All track has been laid on the Columbus, Buckeye Lake & Newark Traction Company's line, and overhead work will be completed by March 1, at which time the line will be placed in operation. Power will be furnished from a temporary power house. A large permanent power station is being erected at Hebron.

LIMA, OHIO.—The Lima Electric Railway & Light Company held its annual meeting a few days ago. The officers are: President and general manager, Joseph B. Mayer; vice-president, Hardin H. Little; secretary-treasurer, H. St. C. Denny; assistant treasurer and superintendent, Wm. T. Harwood. The company was reported to be in an excellent financial condition.

DAYTON, OHIO.—The Mining & Operating Company, with headquarters in this city, has an option on 10,000 acres of coal lands in Muskingum and Guernsey counties. It is the intention to operate the mines by electricity and build an electric railway from West Lafayette to New Concord. It is possible that the line may be extended to Zanesville and used for passenger traffic.

FOSTORIA, OHIO.—The Ohio Northwestern Railway which is building a line from Fostoria to Mungen, has filed a trust deed for $350,000, furnishing funds for the building of the road. Contracts have been let for the construction of car barns, offices, construction cars and a fifteen-ton electric locomotive for construction work to the Consolidated Railway & Light Company, Philadelphia.

PORTLAND, ORE.—The City & Suburban Railway Company, Portland, has purchased from the General Electric Company a 400-kw alternating motor-generator set. The new machinery will be installed in the company's electric power station.

YORK, PA.—The stockholders of the several electric street railway companies, which form the York Traction Company, recently held their annual meeting and elected officers. Captain W. H. Lanius was re-elected president. The companies will extend the Dover Line as far as Dillsburg, a distance of some twenty-one miles. This will take in on the route Wellsville and Franklintown. It is possible that a number of the suburban towns will be lighted from the company's power plant. It is contemplated to have when completed the York Haven Power & Water Company furnish the current to operate the various lines, and then make the present plant a storage for the distribution of the current.

SALT LAKE CITY, UTAH.—J. E. Flattery, of Detroit, asks for a franchise to construct an electric road from Hot Springs, Utah, to Salt Lake City.

APPLETON, WIS.—The new interurban electric railway between this city and Kaukauna has been opened, thus completing the thirty-four miles of interurban accommodation between Oshkosh and Kaukauna, including Neenah, Menasha and Appleton.

NEW INDUSTRIAL COMPANIES.

THE HARLOE INSULATOR COMPANY, of Hawley, Pa., has been incorporated, with a capital stock of $150,000, for the purpose of manufacturing electrical machinery.

THE ELLISSON BROWN ELECTRIC HEATER COMPANY has been formed at Philadelphia to manufacture electric heating apparatus. The capital stock is $250,000.

THE NATIONAL LIGHT SUPPLY COMPANY, of Bloomfield, N. J., has been incorporated; capital, $50,000. Incorporators: Irving H. Brown, Harry B. Perkins and Wm. E. Billings.

THE MASON-BROWN ELECTRICAL SUPPLY COMPANY, New York City, capital, $3,000, has been incorporated by J. H. Mason, G. Brown and Sara Brown, Brooklyn, New York.

THE LAWTON ELECTRICAL COMPANY has been organized at Cincinnati, Ohio, by M. C. Dow, E. M. Lawton, C. H. Schlochter, W. L. Lawton and G. A. Wiltsee. The capital is $10,000.

THE ANGLO-AMERICAN SWITCH & SIGNAL COMPANY has been incorporated in New York City; capital, $5,000. Directors: C. T. B. Rowe, F. V. R. Turk, and A. C. Bostwick, New York City.

THE LOCOMOBILE COMPANY OF AMERICA, New York City, capital $5,000, has been incorporated. The directors are L. A. Beebe, Yonkers, N. Y.; W. L. Marshall, Brooklyn; J. A. Cunnen, New York.

PERSONAL.

MR. ROBERT W. BLACKWELL, of London, England, has returned to New York from his Western trip and will spend some days in this city before sailing.

MR. C. O. MAILLOUX, the consulting electrical engineer, has left for the West, and will spend some time in Arizona, where he has important work in hand.

MR. J. A. MUIR has been appointed general manager of the Los Angeles, Calif., Railway Company, vice Mr. Epes Randolph, retiring for other service, dating from Feb. 15.

MR. W. OWEN THOMAS, lately associated with Mr. Bion J. Arnold, has become chief electrical engineer of the Michigan Lake Superior Power Company, at Sault Ste. Marie, Mich.

MR. C. E. YOUNG has recently been appointed advertising manager for the Western Electric Company of Chicago, and Mr. Ketcham has been promoted to be superintendent of the stock department.

MR. S. SUGIYAMA, a recent graduate of the electrical engineering course of Tokyo University, Japan, is on a visit to the United States with the intention of remaining some months, to be spent in gaining practical experience by entering an American manufacturing works.

PRESIDENT C. A. COFFIN, of the General Electric Company, is expected to make his return from England, it is rumored, in about a week. On his return, it is possible something may be done in the readjustment of General Electric capital. At least, that is the gossip of "the Street."

LIEUT. CALDWELL, U. S. N., of the United States submarine boat "Holland" has been detailed to New York on a special trip to investigate storage batteries for such work, not forgetting the Edison. The desire of the department is to increase the radius given by the batteries without adding to weight, space, etc.

MR. M. C. SULLIVAN, of the N. G. N. Y. Signal Service Corps, has been entrusted with the task of training Company M of the Thirteenth Regiment, of Brooklyn, in signal service work, which he has so successfully specialized of late years. The company is composed mainly of graduates from the Brooklyn High School.

MR. FRANK J. SPRAGUE, who, as everybody knows, was formerly in the Navy, has a charming letter in the *New York Sun* of Feb. 17, full of his reminiscences of Admiral Sampson, who was at the head of the department of physics and chemistry when Mr. Sprague was a cadet in the United States Naval Academy at Annapolis.

MR. MAX LOEWENTHAL has been appointed electrical engineer of the Prometheus Electric Company, of New York, which is now making and introducing electric heating apparatus of a type that has been very successful in Europe. It is based upon the resistance of a fired metallic paint on strips of mica, which gives a great radiating surface.

MR. W. R. BRIXEY, the well known manufacturer of insulated wires and cables, is now recovering rapidly from the severe wounds he received in his rooms at the Murray Hill Hotel in the recent subway dynamite explosion. That he escaped with his life is a miracle. He is at the German Hospital, and will be some weeks before he is able to get about, while some time will probably elapse before he can resume the conduct of his large business.

MR. WILLIAM J. ARKELL, for the last fifteen years president of the Judge Company, has recently severed active connection with it. He has accepted the position of American representative of the new Diesel Motor Company, which was organized in Europe some time ago and which is about to begin operations in this country. The company will have a capital of about $30,000,000. He expects that operations will be begun in New York about June 1. A plant has already been established at Providence, R. I.

MR. THOMAS B. BOOTH, formerly of Washington, D. C., has associated himself with Frederick L. Emery, patent attorney, Boston. Mr. Booth is a graduate of the Massachusetts Institute of Technology, is a member of the bar, and has had several years' practical experience in actual manufacturing, supplemented by a number of years' experience in the United States Patent Office. While in the Patent Office Mr. Booth was examiner in the Electrical Division, where he became thoroughly familiar with the art relating to alternating and direct current systems, generators, motors, controllers, etc., and is generally familiar with the allied and other mechanic arts.

MR. W. H. WHITESIDE, who has for the past three years been manager of the Washington office of the Westinghouse Electric & Manufacturing Company, has been promoted to the position of manager of one of the important commercial departments of the company at the home office in East Pittsburg. Mr. Whiteside has been associated with large electrical projects, and his engineering work in connection with the installation of electrical power in the new dry docks of the United States Navy, especially those at Portsmouth, League Island, and Boston, has been widely recognized. He has also been a strong advocate of the change of voltage from 80 to 125 volts in connection with electrical installations on our battleships and cruisers. He is receiving the congratulations of his numerous friends.

NEW YORK ELECTRICAL SOCIETY.—At the 221st meeting, Feb. 13, 1902, the following were the new members elected: Geo. S. Humphrey, C. W. Hunt Company, West New Brighton, S. I.; William Seaton, Jr., C. W. Hunt Company, 45 Broadway, New York; H. D. Babbitt, 51 Wall Street, New York; H. Lyles Zabriskie, 28 Regent Place, Brooklyn, New York; F. E. Kinsman, 26 Cortlandt Street, New York; John J. McAlister, 1212 Jefferson Avenue, Brooklyn, N. Y.; John T. Blake, 155 South Eighth St., Newark, N. J.; Leroy Harris, 17 Stirling Street, East Orange, N. J.; Axel J. Lundin, 1329 Third Avenue, Brooklyn, New York; Adler B. Gaucher, 208 West Twenty-first Street, New York; David A. Martin, 118 Maple Street, Hoboken, N. J.; E. L. West, J. G. White & Company, 29 Broadway, New York; Ray D. Lillibridge, 20 Broad Street, New York; Clifton V. Edwards, 220 Broadway, New York; David E. Drake, Westinghouse Electric & Manufacturing Company, 120 Broadway, New York; S. Sidney Neu, 20 West Ninety-fourth Street, New York; D. N. Force.

Jr., 138 Mountain Avenue, Montclair, N. J.; W. F. D. Crane, Sanderson & Porter, 31 Nassau Street, New York; Hugh C. Pierce, American Engine Company, Bound Brook, N. J.; Eustace Oxley, General Electric Company, 44 Broad Street, New York; C. H. Van Slyck, General Electric Company, 44 Broad Street, New York; L. H. Lewis, General Electric Company, 44 Broad Street, New York; A. Parshall, General Electric Company, 44 Broad Street, New York; Martin Loewing, 58-60 Reade Street, New York; Albert B. Pacini, 148 West Twenty-fourth Street, New York; Frank W. Smith, The United Electric Light & Power Company, 55 Duane Street, New York; J. P. Burleigh, 180 Stewart Avenue, Arlington, N. J.; William F. Reilly, 12 Manhattan Square, S., New York; M. E. Sanger, 62 Cortlandt Street, New York; Frank H. Berger, 316 Third Avenue, New York; N. A. Cornell, Tucker Electric Construction Company, 35 S. William Street, New York; G. A. Annable, The Cutter Company, 15 Cortlandt Street, New York.

EDUCATIONAL.

THE CREAM CITY ELECTRICAL SOCIETY has been formed in Milwaukee, Wis. It is composed of practical electricians, and will hold meetings every Thursday evening. The following-named officers were elected: Chairman, C. M. Johnson; secretary, James A. Rigby; treasurer, Charles Kruse; instructor, Arthur G. Henrick.

THE QUESTION OF A CAREER.—Thousands of young men are asking themselves how they shall make a start in life. What can they do that will increase their chances of success and lessen the chances of failure? It is significant that many of the great leaders of industrial enterprises are men who have worked with their hands in their youth and have seized their spare moments to train their minds so that they could do the work of their hands with the greatest intelligence, the greatest economy of labor, time and material. Young men who wish to make the most of themselves will be interested in the announcement of the American School of Correspondence. This school teaches entirely by mail and enables students to secure an excellent knowledge of engineering without leaving home or interrupting their regular work.

Trade Notes.

THE ARNOLD & WEATHERBEE COMPANY, electrical contractors, Galveston, Tex., has opened a branch store at 118 Broadway, Oklahoma City, Okla.

ELECTRICAL PORCELAIN.—The Hartford Faience Company, Hartford, Conn., is manufacturing a complete line of electrical porcelain. It will be glad to send catalogues on the subject to all persons interested.

FARADAY CALENDAR.—The February calendar of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, contains an excellent colored portrait of Michael Faraday. On the back is an outline sketch of the great scientist's work and discoveries.

JENNEY UNIVERSAL MOTORS are briefly described and illustrated in Bulletin No. 176, just issued by the Jenney Electric Manufacturing Company, Indianapolis, Ind. A full-page table gives the dimensions, speeds, etc., of the different styles of these machines.

THE TELEPHONE DEPARTMENT of the Electric Appliance Company, Chicago, is having a great demand for its No. 36 cabinet type bridging telephone. This telephone especially equipped with a five-magnet generator is the one the company is pushing for rural line work.

ELECTRIC COFFEE MILLS.—The Enterprise Manufacturing Company of Pennsylvania, Philadelphia, Pa., manufactures electrically driven coffee mills of various sizes and electrically driven meat choppers. Motors for any voltage or class of current are used to drive these machines.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, is running day and night to fill orders for its special coil filament lamps. Mr. Fish, secretary of the company, reports business very satisfactory, the month of July having been one of the best months in the history of the company.

THE WESTERN ELECTRICAL COMPANY, Omaha, Neb., suffered a loss of $20,000 by a recent fire, and before the ruins had cooled off had made arrangements to purchase a complete new stock. It secured temporary quarters at 1515 Howard Street, and is now rebuilding on the old premises. The old stock was completely destroyed by the fire.

HEAVY LATHES.—The Pond Machine Tool Company, 136 Liberty Street, New York, describes and illustrates in a recently issued pamphlet its latest line of heavy and powerful engine lathes. These machines are regularly manufactured in stock sizes, and are uniform and interchangeable. A huge 84-inch lathe is shown in one of the illustrations.

TELEGRAPH SUPPLIES.—Catalogue No. 11 of the Bunnell Telegraphic & Electrical Company, 110 Beekman Street, New York, is devoted almost entirely to descriptions and illustrations of telegraph instruments and supplies. An extensive line of instruments is shown. Wires, bells, pushbuttons, small motors, battery lamps, and some novelties are also listed.

AMERICAN INTERIOR CONDUIT COMPANY, of Waukegan, Ill., claims that the absence of enamel on the thread of its electro-galvanized conduit, elbows and couplings reduces the cost of installation and that the experience of the electrical trade throughout the country supports the assertion, while tending materially toward the rapid increase of its business.

BROWN & SHARPE CATALOGUE.—The 1902 catalogue of the Brown & Sharpe Manufacturing Company, Providence, R. I., has just been issued. It contains 441 pages, and includes a large number of tables and much general information that will be valuable to the workman as a book of reference. A copy of this catalogue can be obtained free on application.

THE CHASE-SHAWMUT COMPANY, Boston, Mass., announces that it has secured large and commodious quarters, and is now manufacturing a full line of fuse wire, fuse links and enclosed fuses; rail bonds, junction boxes, nipples, couplings and cables clips. It states that it is now in a position to make prompt deliveries, having fully recovered from its recent loss by fire.

THE "JONES" UNDERFEED STOKER.—The Underfeed Stoker Company, Limited, New York, points out the good features of the "Jones" Underfeed Stoker in a monthly calendar for this year. There are twelve sheets, corresponding with the number of months, and on each sheet some illustrations and facts about the stoker are given, also illustrations of some of the plants in which this stoker has been installed.

D. L. BATES & COMPANY, of Dayton, Ohio, manufacturers of electric fans, have just issued a very pretty and taking calendar, in which, on a large dark gray card three graces are photographed standing before a Bates fan of 1902, enjoying its grateful breeze, while their hair—just after a sea bath—is being blown about most charmingly and is drying as it streams in the wind. The young ladies look as though they are having a most delightful time.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is meeting with unusual success with its Browning type of Milwaukee small dynamos and motors. They are entirely new, and embody the latest up-to-date ideas, and are adapted for any and all purposes where any electric dynamos or motors could be used. The concern has issued a very attractive bulletin describing this apparatus fully, which is mailed on application.

THE ELECTRIC APPLIANCE COMPANY, Chicago, calls attention to "American" conduit, formerly "Richmondt." The American Interior Conduit Company, the manufacturer of Richmondt electro-galvanized conduit and fittings, has decided to change the name of its product to conform with the name of the company. There is nothing changed but the name, however, unless it is its facilities for handling an increasing business more satisfactorily for the trade.

ELECTRIC SUPPLY & MAINTENANCE COMPANY, formerly of Troy, N. Y. is notifying its friends and customers of its recent removal to Pittsfield, Mass., where it is now located on Reune Avenue, in a building formerly occupied by the Stanley Electric Manufacturing Company, where it will be able, with increased facilities to give better attention than ever to repair work, etc. The officers are J. E. Wilson, President; A. V. Phillips, secretary, and H. G. Hammett, treasurer.

PRESSURE REGULATORS.—The Foster Engineering Company, 107 Monroe Street, Newark, N. J., manufacture the well-known Foster pressure regulator (reducing valve) and other high grade specialties for steam, water, gas or air. In a recent pamphlet the company gives a lot of facts worth knowing about pressure regulators and kindred devices, and describes its very complete line of these goods. These devices are very clearly illustrated. There is a private telegraph code at the back of the book covering five pages.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., is meeting with encouraging success in its recently established department for winding and repairing. It is doing satisfactory work for a constantly increasing number of customers, reaching over a large territory. This department is fitted out with the latest and most improved machinery. Only the best workmen are employed. While all kinds of repair work are solicited, special facilities are offered for winding armatures and repairing commutators.

EXHAUST HEADS.—The B. F. Sturtevant Company, Boston, is sending out some new literature on the subject of its exhaust head. The underlying principle of this exhaust head is centrifugal force. The exhaust steam is given a circular motion in the exhaust head and the weight of water being much greater than that of steam the separation of the watery particles from the steam is effected by the centrifugal force. Hence nothing but dry steam escapes into the atmosphere, while the abstracted water returns by gravity to the proper receptacle.

DISTRIBUTION OF ELECTRICAL ENERGY.—The paper of Mr. L. A. Ferguson, read before the American Institute of Electrical Engineers Nov. 22 last, entitled "Distribution of Electrical Energy in Large Cities," has been reprinted by the Electric Storage Battery Company in its Bulletin No. 69. The particular system dwelt upon in the paper is that of the Chicago Edison Company, in which service there are 912 cells of chloride accumulators employed, having a total of 94,720 ampere-hours' capacity, at normal rate of discharge.

INCREASE OF CAPITAL.—At its annual meeting the Milwaukee Electric Company, Milwaukee, Wis., increased its capital stock from $150,000 to $200,000. The company expects to move into its new plant at West Allis about March 1. The new plant will have triple the capacity of the present one. Officers were elected for the ensuing year as follows: President, John A. Whaling; vice-president, Walter Carey; secretary and assistant treasurer, Thomas G. Whaling; treasurer, Otto R. Hansen. Mr. W. P. Harper, former vresident, recently resigned and also disposed of his interests in the company.

CENTRIFUGAL PUMPING MACHINERY.—Messrs. R. D. Wood & Company, Philadelphia, Pa., have issued a catalogue of 100 pages describing and illustrating their line of centrifugal pumping machinery. The pamphlet is more of a general handbook for users of centrifugal pumps than a mere list of sizes of the company's machines, and contains more descriptive matter and tables of general information than is usually found in catalogues of this class. Messrs. Wood & Company have given close attention to the development of pumps of this class and with their years of experience in this line produce a machine that is regarded as highly satisfactory in practical work. Some of the illustrations show pumps operated by electric motors.

BABY BOOK.—A booklet, entitled "The Baby Book," issued by the American Electric Fuse Company, New York and Chicago, is devoted entirely to protective apparatus manufactured by this concern. Its title is taken from the fact that it contains pictures of forty babies, but the relation between the babies and the subject of the pamphlet is not quite clear, unless it is assumed that the youngsters needed protection. The protective devices are recommended for the protection of electrical apparatus, and as such are now well known in the trade. They are illustrated in all styles, and a brief description accompanies the illustrations. The variety of protectors made by this company may be appreciated from the fact that it takes most of 48 pages to present them. Copies of the "Baby Book" can be had on application.

THE LOMBARD GOVERNOR COMPANY, of Boston, Mass., has just issued a very neat and attractive catalogue illustrating its different types of water wheel and steam engine governors and allied appliances. As the Lombard Governor Company has under control by its governors over 300,000 horse-power of water wheels in this country alone, some idea may be had of the rapid strides that first class speed regulation has made within a comparatively short time. From this fact alone, the new catalogue is well worth reading, as it shows how generally the best results have been sought after in water wheel plants by prominent engineers the country over. Concise and accurate descriptions of all types of Lombard governors are given, while several good photographic illustrations of modern plants with tables are included within its covers.

HOW TO CONSTRUCT RURAL TELEPHONE LINES.—The rapid development in this branch of the telephone business has led the Kellogg Switchboard & Supply Company, of Chicago, to produce a neat 24-page pamphlet (Bulletin No 6), giving directions for the construction of rural telephone lines. Among the contents is a good argument setting forth the advantages and reasons why the farmer should have a telephone, and by following the instructions laid down any farmer should be able to build a telephone line himself. To get the farmers interested in this indispensable instrument so that he can be in touch with the world is the object of the Bulletin. Illustrations of tools used in construction work and apparatus accompany the text and on the last page is given an itemized estimate of the cost of constructing one mile of telephone line.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEBRUARY 11, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

692,248. MUSICAL STRINGED INSTRUMENT; G. H. Davis, New York, N. Y. App. filed April 29, 1899. An electric banjo playing device in which a perforated music strip is used to close the circuit of electric magnets whose armatures fret and pick the strings. (Issued Feb. 4.)

692,700. INSULATING LINING FOR INCANDESCENT LAMP SOCKETS; H. T. Paiste, Philadelphia, Pa. App. filed June 8, 1901. Sheet material roller up to fit the interior of a lamp socket. (Issued Feb. 4.)

692,531. ELECTROLYTIC CELL; E. A. Le Sueur, Rumford Falls, Me. App. filed March 8 ,1898. (See Current News and Notes.)

692,688. APPARATUS FOR PRODUCING FLUORIN; M. Meslans, Paris, France. App. filed Nov. 10, 1900. (See Current News and Notes.)

692,817. ELECTRIC SYSTEM FOR RAILWAYS; D. S. Bergin, Chicago, Ill. App. filed May 11, 1901. A contact plow is secured to the car through a slip-joint, so that the jolting of the car will not alter the relation between the contact device and the conductor.

692,825. OPERATOR'S KEY; A. Carliss, Chicago, Ill. App. filed April 1, 1901. The key consists of a lever projecting through a slot in a plate and having an arc-shaped portion adapted to ride through the slot, thus keeping the slot always closed against dust during the movements of the lever.

692,834. METHOD OF BURNING METALLIC PARTICLES FROM PAPER, ETC.; G. H. Davis, Orange, N. J. App. filed April 17, 1901. The strip of paper is passed between two metal plates forming the terminals of a circuit which is closed when metallic particles in the paper are carried between the plates; the current is heavy enough to burn up the particles.

692,851. TROLLEY HARP AND WHEEL; W. A. Heller, Muskegon, Mich. App. filed Oct. 29, 1901. The harp is provided with upwardly extending angular portions, the inner faces of which approach each other over the flange of the wheel, whereby the wheel is less liable to leave the wire.

692,870. CONTROLLER FOR AUTOMOBILE VEHICLES; H. Lemp, Lynn, Mass. App. filed Nov. 9, 1898. The controller arm is constrained to move in three planes by means of a slotted link. The first motion acts to control the motor circuits to give a forward rotation, the second to break the circuits and retard the vehicle, and the third to connect the circuits in such manner as to give backward rotation. Means are provided for disconnecting the storage battery from the load circuit and including the load for braking purposes on a local circuit with an external resistance. When the armature brake is applied current is shut off from the motor and the controller handle must be returned to the off position in order to re-engage the controller cylinder.

692,874. ELECTRIC AUTOMOBILE; H. Lemp, Lynn, Mass. App. filed Nov. 2, 1900. (See Current News and Notes.)

692,890. ELECTRICAL CONNECTING CORD; C. H. McEvoy, Lowell, Mass. App. filed Nov. 15, 1901. This invention comprises a plurality of insulated or separately covered conductors inclosed nearly throughout their length by a common covering which may be continued to the end of one conductor, while the end portion of another conductor outside or beyond the common covering is provided with a second covering having a continuation which serves as a suspending cord.

692,897. TELEPHONE RECEIVER; James G. Nolen, Chicago, Ill. App filed April 29, 1901. (See page 346.)

692,898. ELECTRIC RAILWAY SYSTEM; B. E. Osborn, Auburn, N. Y. App. filed May 13, 1897. The main conductor runs in a conduit above ground, said conduit being of conducting material and in sections, which are energized from the main conductor by an electromagnetic switch in boxes under the conduit.

692,901. ELECTRICAL GENERATING MACHINE; J. N. Phifer, Shumway, Ill. App. filed Aug. 6, 1901. The casing of a friction generator is connected with air circulating pipes which lead through a moisture-absorbing apparatus for the purpose of keeping the air in the case dry.

692,915. SIGNALING SYSTEM FOR SINGLE TRACK RAILWAYS; W. W. Salmon, Chicago, Ill. App. filed July 21, 1894. Details.

692,916. ELECTRIC RAILWAY SIGNALING SYSTEM; W. W. Salmon, Chicago, Ill. App. filed July 21, 1900. A feature of this invention is the cutting in and out of a large resistance instead of actually breaking and making the circuit. It is claimed that the life of the batteries is prolonged by this method.

692,917. ELECTRIC SIGNALING SYSTEM; W. W. Salmon, Chicago, Ill. App. filed Feb. 4, 1901. Details.

692,959. ELECTRIC SIGNALING SYSTEM; A. J. Wilson, Westfield, N. J. App. filed Nov. 6, 1900. The signal circuit includes a neutral magnet and a polarized magnet by means of which the home and distance signals are controlled, respectively.

692,960. ARMOR OR SHEATHING FOR ELECTRIC CONDUCTORS; E. Witzenmann, Pforzheim, Germany. App. filed Nov. 16, 1901. Lengths of metallic spiral hose capable of being compressed longitudinally and secured together by easily separated couplings whereby the whole of the encased conductor may be exposed piece by piece.

692,966. CONTACT DISK FOR COIN CONTROLLED APPARATUS; C. A. Yale, Burlington, Vt. App. filed April 18, 1901. Details of construction of a contact disk used for advertising and vending purposes.

692,967. TELEGRAPHIC TRANSMITTER; C. E. Yetman, Oakport, Ill. App. filed Feb. 8, 1901. This invention relates to improvements in electric code transmitters of the type which are operated by finger keys similar to those of an ordinary typewriter, and more particularly to such transmitters as are combined with typewriters, the operation of which is governed from the same keys. The improvements are in the various details of construction.

692,974. COMBINED UNDERGROUND AND OVERHEAD ELECTRIC RAILWAY; D. S. Bergin, Chicago, Ill. App. filed March 27, 1901. The trolley pole and the underground collector are connected together electrically and to the motor, so that either of them can be used at will.

692,989. APPARATUS FOR REMOVING METALLIC PARTICLES FROM STRIPS OR WEBS; G. H. Davis, Brooklyn, N. Y. App. filed April 17, 1901. Covers the apparatus for carrying out the method described in patent No. 692,834.

693,001. PRIMARY BATTERY; J. W. Frees, Reading, Pa. App. filed May 15, 1901. The outer cell is lead, next comes a porous vessel containing the zinc and between the lead and porous vessels, lead chlorid is inserted to prevent the formation of hydrogen on the surface of the lead vessel.

693,003. FIRE DETECTOR AND ALARM; F. G. Gaschlin, San Francisco, Calif. App. filed May 13, 1901. Detail.

693,013. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed April 8, 1889. Relates generally to the details of circuit controllers such as are used for automatic signal transmission.

693,014. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Aug. 5, 1890. A chemical annunciator comprising a series of line terminals, a co-operating marking surface arranged to be brought into and out of contact with the terminals together with a reservoir holding a supply of electrolyte and arranged to feed it to the said surface.

693,023. ELECTROMAGNETIC REGULATOR FOR ELECTRIC CURRENTS; J. D. Ihlder, Yonkers, N. Y. App. filed April 17, 1900. The contacts of a rheostat constitute the movable armatures of a magnet having a number of poles, the armatures being placed at gradually increasing distances from the poles and the resistance being cut out as the strength of the magnet increases.

693,035. PROCESS OF THE ELECTROLYTIC MANUFACTURE OF CHLORATES AND PERCHLORATES; P. L. E. Lederlin, Chedde, France. App. filed July 19, 1901. (See Current News and Notes.)

693,038. ELECTRIC ELEVATOR; N. O. Lindstrom, New York, N. Y. App. filed Nov. 9, 1901. The armature of the actuating machine carries two circuits, one a driving circuit and the other a generating circuit. The circuits contain resistances which are controlled from the car to alter the speed, whether the machine be driving or itself driven.

693,041. ELECTRIC ARC LAMP; S. M. Meyer, Brooklyn, N. Y. App. filed March 12, 1901. A lamp adapted for incandescent circuits and fitted with a plug and portable so that it can be readily carried from one room to another and put into circuit wherever desired.

693,063. ELECTRIC MASSAGE ROLLER; W. B. Breston, Chicago, Ill. App. filed Dec. 4, 1901. Three rollers are arranged on the same axis side by side, the middle roller being of insulating material and the outer ones, the terminals of a circuit.

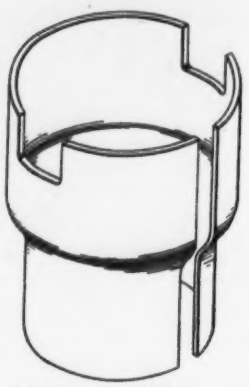
693,067. ELECTRIC BURGLAR ALARM; H. C. Roome and W. G. Roome, Jersey City, N. J. App. filed Feb. 28, 1895. Details.

693,068. ELECTRICAL BURGLAR ALARM; H. C. Roome and W. G. Roome, Jersey City, N. J. App. filed March 24, 1899. A choke coil is placed in the circuit of the guarded structure, whose value can be altered at will from the central office without unbalancing the indicating device at the central office. The coil renders it impossible for a burglar to tamper with the circuits without sending in an alarm.

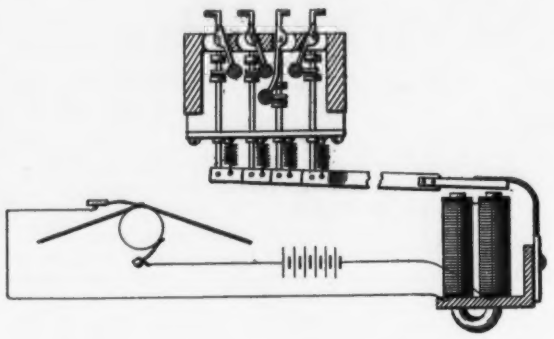
693,092. ELECTRIC HOSE SIGNAL SYSTEM; G. G. Weitz, Medford, Mass. App. filed July 19, 1901. A mechanical construction of a coupling at the end of the hose where it joins the engine, whereby the coupling is made a part of the signaling circuit without including the engine itself.

693,094. SIGNAL AND SIGNALING CIRCUIT; J. A. Wilson, Westfield, N. Y. App. filed Aug. 13, 1900. The home and distant signals are operated by one motor, the clutches for connecting one or the other signals with the motor being automatically operated.

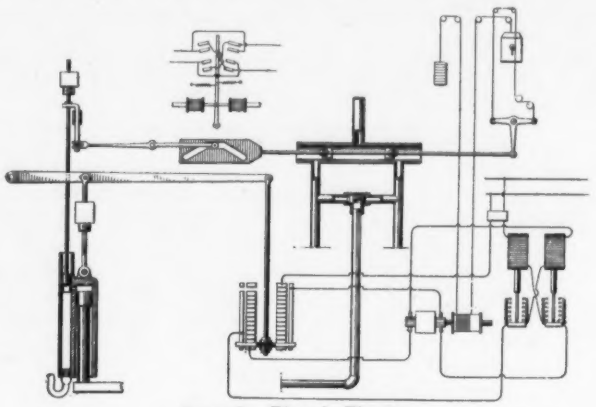
693,098. ROTARY TRANSFORMER; R. E. Ball, New York, N. Y. App. filed Dec. 19, 1900. In a rotary transformer, an armature wound with a coil for



692,700.—Insulating Lining for Incandescent Lamp Sockets.



692,248.—Music Stringed Instrument.



693,038.—Electric Elevator.

both primary and secondary currents, a plurality of commutator segments connected at intervals to the coil, primary brushes conveying current from an outside source to the armature through the commutator, secondary brushes conducting current from the armature and means independent of the armature for producing rotation between the commutator and brushes.

693,109. SIGNAL OPERATING APPARATUS; C. W. Coleman, Chicago, Ill. App. filed Oct. 24, 1900. The motor is adapted to operate automatically two signals independently of each other.

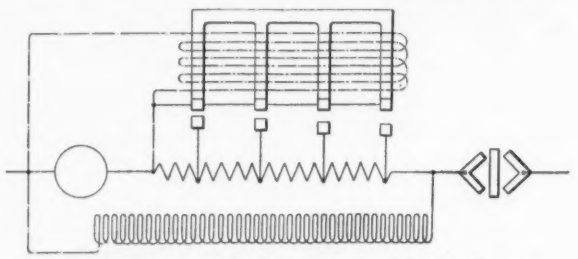
693,110. ELECTRIC CIRCUIT CONTROLLER; C. J. Coleman, New York, N. Y. App. filed Nov. 24, 1900. A circuit controller including a cup designed to hold mercury, as one contact, an immersing point as the other contact, and a vessel adapted to contain a suitable liquid to envelope the cup and the point.

693,144. ELECTRICALLY HEATED APPARATUS; V. Monath, Vienna, Austria-Hungary. App. filed April 16, 1901. Details.

693,146. MEANS FOR PRESERVING AND RENDERING SHARP CUTTING EDGES, ETC.; O. Newhouse, San Francisco, Calif. App. filed May 11, 1901. The edge of a blade is placed in proximity to a magnet and retained in that position for a period of time in order to rectify its edge.

693,162. HOT AIR SYRINGE; A. W. Schramm and E. B. Wilford, Philadelphia, Pa. App. filed May 15, 1901. An electric heater is inserted in the nozzle of the syringe, to heat the air on its passage therethrough.

693,184. ELECTROPNEUMATIC CONTROL SYSTEM FOR ELEVATORS; A. Sundh, New York, N. Y. App. filed Sept. 20, 1901. Pneumatic devices



693,023.—Electromagnetic Regulator for Electric Currents.

and connections for calling and sending the car from one station to another and operating in conjunction with the electric motor controlling means.

693,206. WIRE CONNECTOR; H. W. Wyckoff, Chicago, Ill. App. filed May 6, 1901. The connector consists of two metal plates having opposing faces each provided with two grooves of different cross-sections located opposite similar grooves in the other face, and a bolt to hold the plates together.

693,213. ANCHOR FASTENER FOR LIGHTING CONDUCTORS; C. Bajohr, St. Louis, Mo. App. filed Dec. 4, 1901. A con-corrosive bracket adapted to be set between the bricks of a wall and to receive the conductor at its projecting end.

693,216. ELECTROLYTIC ELECTRICITY METER; C. O. Bastian, London, Eng. App. filed Oct. 14, 1901. The method of preventing over-heating of the electrodes of an electrolytic meter at the upper surface of the electrolyte, which consists in preventing the access of air or other gases to the electrode at that point.

693,222. INCANDESCENT LAMP; H. Hoehm, Youngstown, Ohio. App. filed Oct. 11, 1901. Signal lamps made with recesses in the sides of the bulb to which the leading-in wires lead and are there connected with plates set into the recesses.

693,244. ELECTRIC RAILWAY CONSTRUCTION; F. P. Derr, Baltimore, Md. App. filed Sept. 11, 1901. Details

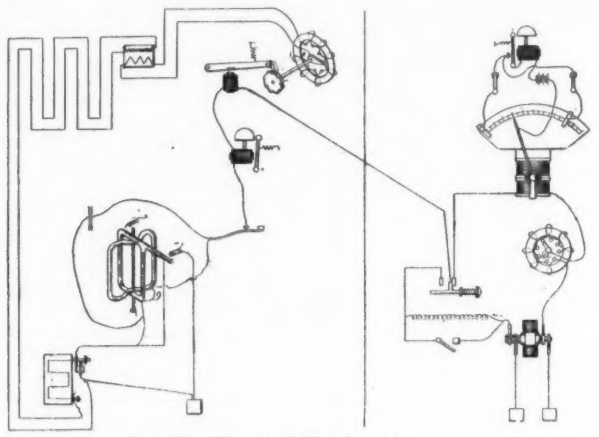
693,257. ELECTRICAL DEVICE FOR THE TREATMENT OF DISEASES; W. J. Gavigan, New York, N. Y. App. filed Nov. 19, 1901. One electrode is made flexible and of a shape to fit against the spinal column, while the other is to be applied to a diseased part.

693,262. SELF-ADJUSTING ELECTROMAGNETIC CIRCUIT CLOSING MECHANISM; G. W. Gillespie, London, Canada. App. filed April 27, 1901. A claim describes the invention as follows: The combination with an electromagnetic motor and a counter-tension device, of a circuit closer connected for actuation to said motor and counter-tension device, and means operating upon a variation in the magnetic force acting upon said circuit closer for effecting a proportional change in said counter-tension device, whereby substantially the same differential force is maintained in each of a series of adjustments.

692,274. ELECTRIC AUTOMOBILE; H. Lemp, Lynn, Mass. App. filed Nov. 2, 1900. The motor is mounted in such a manner that its armature shaft extends at right angles to the plane of the axle; a worm on the motor shaft drives a worm wheel, to which is attached the keeper of a magnet, the magnet itself being mounted on the hub of the driving wheel—the latter arrangement forming a magnetic clutch. The coil of the clutch is in series in the motor circuit and is broken each time the supply of energy to the motor is interrupted.

693,275. ELECTRIC SWITCH; J. Jones and J. Jones, Jr., Brooklyn, N. Y. App. filed May 31, 1901. An ordinary hand-operated rotary switch placed out of reach, is arranged to be operated by means of a cord and devices which engage with the rotary button of the switch.

693,308. SIGNAL SYSTEM; E. Peterson, St. Hilaire, Canada. App. filed July 5, 1901. A box containing train order blanks interlocks with a signal



693,068.—Electrical Burglar Alarm.

in such a manner that a signal is operated while an order black is out of place.

693,309. TROLLEY HEAD; D. A. Petre, Duluth, Minn. App. filed May 7, 1901. Details.

693,320. VALVE AND ALARM; F. Gray, Chicago, Ill. App. filed July 13, 1899. An alarm device applied to sprinkler systems to give notice when the system is out of order or is tampered with.

693,322. ALARM FOR FIRE EXTINGUISHING SYSTEMS; F. Gray, Chicago, Ill. App. filed June 11, 1897. In connection with a dry-pipe fire extinguishing system, an alarm apparatus is used which gives a preliminary alarm upon the escape of the air from the pipe and a subsequent alarm upon the introduction of the water into the dry-pipe.

693,351. OVERHEAD TROLLEY ELECTRIC RAILWAY; B. D. Gilson, Alexandria, Ind. App. filed June 3, 1901. Details.

693,355. ELECTRICAL DISTRIBUTOR; C. J. Springer, Somerville, Mass. App. filed Oct. 15, 1900. A duplex automatically operating relay adapted to be set in motion by the closing of a circuit and in turn either successively or simultaneously to close one or more secondary circuits, which may include light, bells or other devices.

693,356. TELEPHONE SYSTEM; Frans Birger Stafsing, Stockholm, and Carl Egner, Klippan. App. filed July 16, 1900. (See page 346.)